

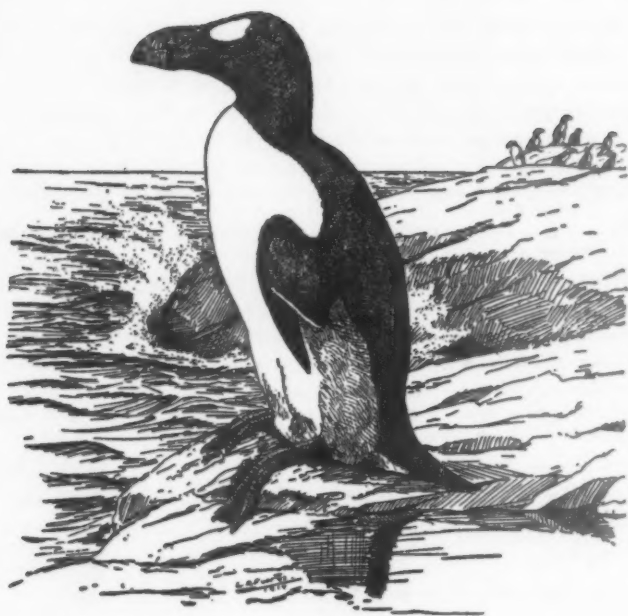
# The Auk

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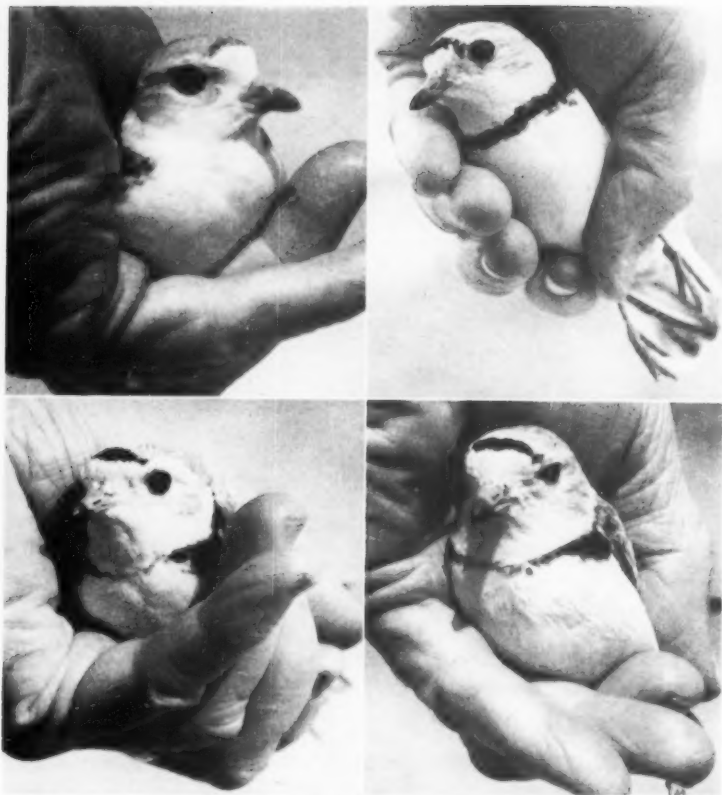
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Types of chest markings in Piping Plover (*Charadrius melodus*) trapped on nests on Long Island, New York. *Above left*: 'White gap.' Male, May 9, 1957. Banded as adult 1956, returned 1957, 1958. *Above right*: 'Full belt.' Male. June 8, 1951. Banded as adult 1950, returned 1951, 1952. *Below left*: 'Intermediate' with light connecting ring. Male. June 3, 1955. Banded as adult 1955. *Below right*: 'Intermediate' with medium connecting ring. Male. May 24, 1956. Banded as adult 1951, returned 1953, 1956, 1957. (Photos. by L. Wilcox.)

# THE AUK

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### A TWENTY YEAR BANDING STUDY OF THE PIPING PLOVER

BY LE ROY WILCOX

Relatively little has been published about the life history of the Piping Plover (*Charadrius melodus*). The account by Tyler (in Bent, 1929: 236-246) is brief. Banding is probably the best means of learning the intimate details of the home life of many birds. The initial work of this nature with the Piping Plover began in 1911 with the banding of a young bird by Howard Cleaves on Gardiner's Island, off eastern Long Island, New York. For the next twenty-six years, until 1937, Fish and Wildlife records indicate that only 275 young were banded, of which there were but two returns.

In 1937 I started systematic trapping of as many adult nesting Piping Plovers as possible, in an effort to learn various aspects of their life history. Up to that time we did not know the incubation period, whether both sexes incubated, whether more than one brood was reared in a season, whether the adults nested in the same general locality from year to year, whether birds returned to the nest in the area where they were hatched, or whether the sexes could be identified in the field. Between 1937 and 1958 I banded a total of 1,723 individuals in an area on the south shore of eastern Long Island, New York. Only my results for the first two years—1937 and 1938—have been published (Wilcox, 1939). This is a summary of the salient results.

For comparative purposes, I checked the files of the Bird Banding Office, United States Fish and Wildlife Service, for all banding records of the Piping Plover up to December, 1956.

#### NUMBERS BANDED AND RETURNS

By July, 1958 I had banded 744 adults and 979 young. The annexed Table 1 shows details as to my own banding and return

data by years. Up to July, 1958, omitting 71 young and 57 adults banded that year, my returns were 433 out of 1,595 banded—amounting to about 27%.

Up to December, 1956 the total number of Piping Plovers reported banded in the United States and Canada by 80 banders was 2,377, of which I had banded 1,504. Of the 662 adults banded, I had banded 642. The remaining 1,715 were young, of which I had banded 862 (979 by July 1958). By far the largest numbers have been banded in the three states of New York, Massachusetts and New Jersey.

New York heads the list to December 1956 with 1,934, of which 1,910 were banded on Long Island. Massachusetts is next with 207, and New Jersey with 118. Other banding areas were: Canada 31, Michigan 30, Ohio 12, Maryland 10, Rhode Island 8, Pennsylvania 7, New Hampshire 5, Minnesota 5, Wisconsin 4, Virginia 3, Illinois 2, and Maine 1.

Up to December, 1956 the total number of all returns for this species was 390; of these 380 bore my bands. This is the largest number of returns of any North American shorebird.

Of the 433 returns bearing my bands 425 were trapped by me on their nests; 5 were found dead on their nesting grounds during the nesting season (killed by cars or by flying into telephone wires); and 3 were collected by other persons, two of them near the area where they previously nested.

The 5 found dead were as follows: female banded on June 3, 1939 at Moriches Bay and found dead on May 24, 1940, 102 feet from its nest; male banded on June 3, 1939 at Moriches Bay (retrapped there on June 1, 1940 and May 31, 1941) and found dead there on May 13, 1942, 57 feet from its 1941 nest; female banded on May 17, 1941 at Shinnecock Bay and found dead there on June 2, 1944, 200 feet from its 1941 nest; male banded on May 19, 1944 at Moriches Bay (retrapped there on May 12, 1945) and found dead there on April 3, 1948, 300 feet from its 1944 nest; female banded on May 31, 1947 at Shinnecock Bay and found dead there on June 24, 1948, about 9,430 feet west of its 1947 nest.

The 3 collected were as follows: female banded on June 21, 1940 at Moriches Bay and collected on April 2, 1941 at Hog Island, Virginia, probably on its way north to nest again on Long Island as it had done the previous year; banded as young on June 13, 1947 at Shinnecock Bay, trapped on its nest on June 24, 1950 as full belted male at Moriches Bay and collected on August 28, 1954 at Moriches Inlet, about two miles west of where it nested in 1950; male banded on June 9, 1950 at Moriches Inlet and collected there on July 31, 1954.

The ten returns of birds banded by others were all banded when young: banded June 12, 1924 at Barnstable, Massachusetts, shot April 3, 1926 at Isle of Palms, South Carolina; banded July 11, 1933 at Seabrook, New Hampshire, and shot there for specimen on August 21, 1933; banded July 3, 1938 at Oak Island, Long Island, New York and found dead on August 27, 1938 at Gilgo, Long Island, New York; banded July 14, 1939 at Atlantic Beach, Long Island, New York, and trapped by me on its nest on June 29, 1940 at Shinnecock Bay, Long Island, New York;

TABLE 1  
PIPING PLOVER Banded and RETURNS

Year	Young Banded	New Adults Banded	Returns on Nests	Total Adults Trapped on Nests	Nesting Area	Extent of Nesting Area-Miles	No. Nests	% Known Nesting Adults Trapped
1936	1	—	—	—	Mo	1	—	—
1937	21	12	—	12	Mo	—	9	66
1938	42	29	7	36	Mo	2	20	90
1939	42	37	9	46	Mo-Sh	17	25	92
1940	98	82	30+ (1)	113	Mo-Sh	17	60	94
1941	162	75	44+ (1)	120	Mo-Sh	17	64	93
1942	101	42	56	98	Mo-Sh	17	54	90
1943*	—	2	5	7	Mo	1/2	4	90
1944	36	53	21	74	Mo-Sh	17	41	90
1945*	3	3	2	5	Mo	1	3	83
1946*	—	—	—	—	—	—	—	—
1947	85	43	10	53	Mo-Sh	17	28	94
1948	43	44	19	63	Mo-Sh-Me	22	34	92
1949	62	62	19	81	Mo-Sh-Me	22	45	90
1950	60	57	41	98	Mo-Sh-Me	22	55	89
1951	25	28	28	56	Sh-Me	14	32	86
1952	16	17	25	42	Sh-Me	14	23	91
1953	2	12	14	26	Sh-Me	14	17	76
1954	6	11	11	18	Sh-Me	14	9	100
1955	20	20	16	36	Sh-Me	14	20	90
1956	25	17	15	32	Sh-Me	14	18	86
1957	46	45	16	61	Mo-Sh-Me	22	34	90
1958	71	57	37+ (1)	95	Mo-Sh-Me	22	50	95
Total	969	744	425+ (3)	1172			645	91

Omitted are 10 birds banded by me as young in 1929 and 1931 on Long Island, only 4 of which were banded (in 1929) within the area; none were retrapped. Not included under Returns are 5 of my banded birds found dead or known to have been collected. The figures in parentheses under Returns indicate birds trapped by me which had been originally banded outside the nesting area by others. "Mo" = Moriches; "Sh" = Shinnecock; "Me" = Mecox.

\* As a result of gasoline limitations during war years, very little trapping was done in 1943 and 1945, and none in 1946.

TABLE 2  
RETURNS OF SHOREBIRDS BANDED IN NORTH AMERICA TO DEC. 1956

Species	No. Banded	No. Returns	Percentage
American Oystercatcher ( <i>Haematopus palliatus</i> )	69	1	1.4
Semipalmated Plover ( <i>Charadrius semipalmatus</i> )	654	1	.1
Piping Plover ( <i>Charadrius melodus</i> )	2,377	390 (375)*	16.4
Wilson's Plover ( <i>Charadrius w. wilsonia</i> )	96	2	2.0
Killdeer ( <i>Charadrius v. vociferus</i> )	4,429	43 (7)	1.0
American Golden Plover ( <i>Pluvialis dominica</i> )	49	1	2.0
Black-bellied Plover ( <i>Squatarola squatarola</i> )	23	2	8.7
Ruddy Turnstone ( <i>Arenaria interpres morinella</i> )	92	2	2.1
American Woodcock ( <i>Philohela minor</i> )	9,070	300	3.3
Common (Wilson's) Snipe ( <i>Capella gallinago delicata</i> )	1,099	36	3.3
Long-billed Curlew ( <i>Numenius americanus</i> )	105	3	2.9
Whimbrel (Hudsonian Curlew) ( <i>Numenius phaeopus hudsonicus</i> )	20	1	5.0
Upland Plover ( <i>Bartramia longicauda</i> )	247	2	.8
Spotted Sandpiper ( <i>Actitis macularia</i> )	4,311	99 (2)	.9
Willet ( <i>Catoptrophorus semipalmatus</i> )	445	4	.9
Greater Yellowlegs ( <i>Totanus melanoleucus</i> )	319	6	1.8
Lesser Yellowlegs ( <i>Totanus flavipes</i> )	764	5	.6
Knot ( <i>Calidris canutus rufa</i> )	23	2	8.7
Pectoral Sandpiper ( <i>Erolia melanotos</i> )	515	1	.2
Least Sandpiper ( <i>Erolia minutilla</i> )	6,989	169	2.4
Dunlin (Red-backed Sandpiper) ( <i>Erolia alpina arctica</i> )	363	3	.8
Short-billed Dowitcher ( <i>Limnodromus griseus</i> )	434	4	.9
Semipalmated Sandpiper ( <i>Ereunetes pusillus</i> )	12,593	91	.7
Western Sandpiper ( <i>Ereunetes mauri</i> )	2,113	4	.2
Marbled Godwit ( <i>Limosa fedoa</i> )	277	7	2.5
Sanderling ( <i>Crocethia alba</i> )	310	2	.6
American Avocet ( <i>Recurvirostra americana</i> )	369	2	.6
Black-necked Stilt ( <i>Himantopus mexicanus</i> )	300	4	1.3
Other Species	823	—	—

\* Figures in parentheses indicate number of birds retrapped as returns on their nests in a subsequent year.

banded July 15, 1939 at Oak Beach, Long Island, New York and trapped by me on its nest on May 10, 1941 at Shinnecock Bay, Long Island, New York; banded July 15, 1939 at Oak Beach, Long Island, New York, and found injured on March 22, 1942 at Hunting Island Beach, Beaufort County, South Carolina; banded July 13, 1941 at Penn Yan, New York and trapped over its young on July 7, 1943 at Long Point Beach, Ontario, Canada; banded July 12, 1947 at Ocean City, Maryland and found dead on October 22, 1947 at Sword Fish Creek, Great Bahama Island; banded on July 24, 1954 at Beach Haven, New Jersey and shot on September 8, 1954 at Holgate, New Jersey; banded on June 17, 1956 at Mackinaw City, Michigan and shot at same place on July 5, 1956.

Aside from the Piping Plover, apparently no banding has been done of shorebirds on their nests, except for a few Spotted Sandpipers (*Actitis macularia*) and Killdeer (*Charadrius vociferus*). Of the 49,278 individuals of 47 species of shorebirds banded in the United States and Canada up to December, 1956, there have been 1,127 returns, or 2.3 per cent. Of this total, 2,377 represented Piping Plovers, of which there had been 390 returns to December, 1956, or 16.4 per cent. On the attached Table 2 are the comparative results of banding of shorebirds in North America. In Table 2, the percentage figure of 1956 is computed, to simplify comparison, by dividing the total returns by the total banded, though a more correct method might be to omit birds newly banded in the last year of computation, since there could be no returns of those birds on the nest the same year.

The much greater percentage of returns of Piping Plover is undoubtedly the result of the greater number of adults of this species trapped on their nests. Of 1,504 Piping Plovers banded by me, up to December, 1956 I had had 380 returns, or 25.2 per cent. Of the 873 Piping Plovers banded by others, very few of them on their nests, there had been only 10, or 1.1 per cent, of returns. The probability

TABLE 3  
RETURNS OF SPOTTED SANDPIPER AND KILLDEER Banded ON NESTS

Locality	Banded	Retrapped	Distance from Nest
SPOTTED SANDPIPER			
Quebec, Canada	June 15, 1950	June 27, 1952	100 feet
Quebec, Canada	June 15, 1951	July 5, 1952	50 feet
KILLDEER			
Mayfield Heights, Ohio	June 14, 1929	May 13, 1931	"about same spot"
Manorville, New York	June 4, 1937	May 31, 1938	100 feet
Long Beach, California	May 15, 1940	May 15, 1941	"about same spot"
Montreal, Canada	June 4, 1944	June 15, 1946	2,000 feet
Montreal, Canada	June 8, 1945	June 13, 1948	500 feet
Collegeville, Indiana	April 21, 1947	June 13, 1948	100 feet
Montreal, Canada	May 17, 1953	April 21, 1954	2,000 feet

that other shorebirds also return to nest in the same localities in successive years is suggested by the scanty returns of Killdeer and Spotted Sandpiper (Table 3).

#### TRAPPING

In the large majority of trappings, the bird caught first on the nest when released would start flying around the area, calling to locate its mate, which would then go on the nest. Some males and females remained on the nest after the trap dropped over them, but most, though first moving off, in a few seconds went back on the nest to incubate the eggs. There were no fatalities in the trapping of any adults on their nests. In several instances both nesting birds were caught together on the nest.

The quickest and easiest way to find nests is to retire to a car, or other place of concealment and watch the adults with binoculars. They will soon go back to the nest, if one is at least 300 feet from the nest. For example, in 1943 I started operations on May 15 and found 17 nests, of which 11 were found in one hour. Seven adults were trapped that first day on their nests.

I use drop traps about thirty inches square and four inches high of one-quarter inch mesh wire. One side of the trap is rested on the ground while a stick under the opposite side raises it about seven to eight inches above the ground. It is very important to place the trap so that the nest is near the back part of the trap and the stick must be resting on a large piece of shell or other hard object on the ground or else the stick will dig into the sand and the trap will not drop quickly or properly. The string is tied to the bottom of the stick and must be run out 300 to 500 feet from the nest to a convenient hiding place. On windy days the back part of the trap must be worked down into the sand and small piles of sand placed at each corner of the back part of the trap. The average time required to trap 206 males was 9.2 minutes each and for 206 females 10.5 minutes.

#### NESTING AREA

Piping Plovers on Long Island favor dry sandy outer beaches. They normally arrive on their nesting grounds in this area during the last week in March (for the status on Long Island, see Cruickshank, 1942: 168-170).

For the first year (1937) of my study, the Piping Plover nesting area was a one mile stretch of outer beach, and in 1938 a two mile stretch of such beach, just east of Moriches Inlet, between the Atlantic Ocean and Moriches Bay on the south shore of Long Island, New York, about 70 miles east of New York City. In 1929, when I banded my first young, only two or three pairs had been nesting at Moriches Bay and one pair at Shinnecock Bay, an area about seventeen miles long. In March 1931 the ocean broke through the outer beach into Moriches Bay, forming Moriches Inlet. This Inlet has moved one mile west

from 1931 to 1956. That 1931 storm and subsequent storms increased the nesting sand area, so that twenty pairs were nesting in the two miles of beach by 1938. Then the center of the great hurricane of September 21, 1938 hit this area a devastating blow, levelling the sand dunes at Moriches and Shinnecock Bays and opening a new inlet into the latter bay, known as Shinnecock Inlet. The 1938 storm produced about a three mile continuous strip of nesting area at Shinnecock and about a four mile continuous sand strip at Moriches.

The peak number of nesting plovers in this seventeen mile stretch of sand beach—from Moriches Inlet east to the village of Southampton at the east end of Shinnecock Bay—was reached in 1941 when there were 64 pairs. This maximum number was maintained for about three years (1940, 1941 and 1942). After that there was a gradual decline due to the dredging of sand from the bay bottom in both bays and its deposition upon the beach to build up the sand dunes to about their former height. Then the native beach grass (*Ammophila breviligulata*) was planted by hand to hold the sand from blowing. Plovers still continued to nest for two or three years on these artificial sand dunes but they deserted them after this period because of growth of the grass. They preferred to nest in large open grassless sand areas north of the sand dunes, but a few nested in sand areas as small as 200 to 300 feet long. After the grass covered the sand dunes again, most of the nesting plovers left the area for more suitable habitat, probably on other parts of Long Island. But a few scattered pairs continued to nest south of the sand dunes between the surf and the dunes, where the nesting area was wide and high enough so that the high tides did not reach it.

Beginning in 1939 and up to 1950 I worked the area from Moriches Inlet to Southampton. During World War II rationing of gasoline and the banning of pleasure driving and of binoculars along the outer beaches greatly curtailed work on the plovers in 1943 and 1945, and prevented any work in 1946. By 1951 there were hardly any plovers nesting at Moriches Bay in their former nesting area, in part because of the growth of grass, but mainly because of the extensive building of summer homes in this area, leaving no large dry sand areas, except one of about a mile just east of Moriches Inlet. There is a road running parallel with the outer beach the entire distance of seventeen miles from Moriches Inlet to Southampton, except for this one mile of beach just east of Moriches Inlet. On this entire nesting strip running east and west there were hardly any areas wide enough from north to south for more than one pair.

From 1948 to 1958 I extended operations a little farther east to include Mecox Bay, about five miles east of Shinnecock Bay, which is the next nesting area eastward across Shinnecock Inlet.

Most of the nesting birds were trapped from my car. This provided a "blind" which made trapping much easier than if I had been forced to hide in the grass. The birds settled down more quickly and went under the trap much sooner.

#### TERRITORY

Seldom will one pair nest nearer than 100 feet from the nest of another pair. Nests found were usually spaced 200 feet or more apart.

If a bird is on the nest, it usually will chase away adult plovers other than its mate when they approach within about 100 feet. Even after the downy young are out of the nest, the parents will chase away other adults if they come near, for the young remain a few hundred feet from the nest site until they are able to fly, unless forced to run by some predator or other disturbing factor.

#### TENDENCY TO RETURN TO NESTING AREA

The Piping Plovers at Moriches Bay, Shinnecock Bay and Mecox Bay comprise three nesting populations. Though on the same continuous strip of barrier beach, the nesting area at Mecox is separated from that at Shinnecock by about five miles where no plovers nested, owing to a built up section of summer homes and absence of sandy areas. Likewise between Shinnecock and Moriches there is also a five mile gap (including a narrow water separation) where none have nested.

*Adults.* My data indicate that adults banded on their nests return in succeeding years to the same nesting area, with few exceptions. Of the 1,173 adults trapped on their nests up to July 1958, 288 individuals were retrapped in later years (many of them several times), and only three were found to have left their original nesting area to nest in one of the other two areas.

These three adults were: female banded May 30, 1942 at Shinnecock returned June 2, 1949 at Moriches, 15.6 miles west of its 1942 nest; male banded as young June 23, 1949 at Mecox, taken as adult on nest May 17, 1951 at Shinnecock, 5.5 miles west of where hatched, taken again on nest June 12, 1953 back at Mecox, 600 feet from where it was hatched in 1949; female banded June 16, 1950 at Moriches taken on June 18, 1952 at Shinnecock, 11.1 miles east of its 1950 nest.

*Young birds.* Young hatched in any of these three areas (Moriches, Shinnecock, or Mecox) may come back to nest in any of them—not

necessarily the one in which they were hatched. Moreover the trapping for the past five years in these areas of from 39 to 73 per cent of unbanded adults suggests that part of the population consists of birds hatched outside my study area. But some of these unbanded birds are doubtless local individuals that I failed to band, especially young, for I only banded about 36 per cent of the young in nests found.

Out of 979 young banded to July 1958, 47 returned to nest in one of the three areas, of which 34 returned to the area in which they were hatched and 13 to an area in which they were not hatched. The 34 young returning to nest in the area in which they were hatched nested at distances between 650 feet and about six miles from the spot where they were hatched (Table 4). Distances could be estimated because of known spacing of telephone poles.

TABLE 4  
DISTANCE OF NEST FROM PLACE OF HATCHING

Males				Females			
Hatched	Nested	Locality	Approximate Distance in Feet	Hatched	Nested	Locality	Approximate Distance in Feet
1939	1940	Moriches	950	1937	1940	Moriches	650
1939	1940	Moriches	1,000	1937	1939	Moriches	990
1947	1950	Shinnecock	1,580	1940	1941	Moriches	1,340
1940	1942	Moriches	2,500	1938	1940	Moriches	1,420
1957	1958	Shinnecock	4,260	1941	1942	Moriches	2,480
1942	1949	Moriches	5,060	1937	1938	Moriches	2,640
1936	1940	Moriches	5,280	1948	1950	Shinnecock	3,260
1949	1950	Shinnecock	5,740	1940	1941	Shinnecock	4,400
1938	1940	Moriches	5,800	1940	1942	Shinnecock	4,750
1944	1947	Shinnecock	6,330	1942	1947	Moriches	7,390
1950	1952	Shinnecock	8,210	1951	1952	Shinnecock	7,560
1957	1958	Shinnecock	8,360	1957	1958	Shinnecock	8,230
1950	1951	Shinnecock	8,370	1950	1951	Shinnecock	10,540
1949	1954	Shinnecock	9,900	1940	1942	Moriches	11,610
1939	1944	Shinnecock	16,890	1947	1958	Shinnecock	13,410
1940	1944	Shinnecock	30,620	1939	1941	Moriches	22,700
				1950	1951	Shinnecock	24,550
				1956	1957	Shinnecock	22,620

The thirteen young found nesting in an area where they were not hatched nested at distances of from five to about 18 miles from the spot where they were hatched (Table 5).

To July 1958 out of 979 young banded, only 47 were trapped on nests in or near the area where they were hatched—4.7 per cent. This seems like a very low percentage of returns. No doubt a few more than the 47 young actually returned, as I was only successful in trapping 90.5 per cent of all nesting adults on the 646 nests found. On these 646 nests, 1,173 adults were trapped out of a possible 1,292,

TABLE 5  
DISTANCE OF NEST FROM PLACE OF HATCHING OF BIRDS  
BANDED AS YOUNG WHICH MOVED

		Males		Approximate Distance, Feet
Hatched		Nested		
1949	Mecox	1954	Shinnecock	28,560
1949	Mecox	1951	Shinnecock	28,850
1938	Moriches	1939	Shinnecock	66,000
1947	Shinnecock	1950	Moriches	79,460
1947	Moriches	1951	Shinnecock	80,250
1956	Shinnecock	1958	Moriches	83,050

		Females		Approximate Distance, Feet
Hatched		Nested		
1948	Mecox	1949	Shinnecock	28,910
1949	Mecox	1954	Shinnecock	36,430
1950	Moriches	1952	Shinnecock	59,660
1955	Shinnecock	1958	Moriches	65,100
1940	Shinnecock	1941	Moriches	66,000
1938	Moriches	1939	Shinnecock	81,840
1948	Moriches	1950	Shinnecock	85,940

missing 119. I estimate that I found about 90 per cent of all nests in the areas worked.

Probably we can never ascertain what per cent of the 979 banded young survived the first winter to return north to nest for the first time, and what per cent nested in other parts of the Piping Plover's breeding range (Canada to North Carolina), rather than in my area of Long Island. Of course, many of them could have returned to other parts of Long Island, as the area that I worked was only about one-sixth of the total nesting area on the south shore of Long Island. Unfortunately there has been almost no trapping of nesting plovers elsewhere on Long Island. Out of 374 young banded by others on western Long Island (28 to 55 miles west of my study area) only two were recovered breeding in my area (at Shinnecock Bay).

To 1956 out of the 853 young banded by others in North America only three had been trapped in later years on their nests. The three were: female, banded on July 14, 1939 at Atlantic Beach, Long Island, New York, which I trapped on its nest on June 29, 1940 at Shinnecock Bay about 63 miles east of where it was hatched; female, banded on July 15, 1939 at Oak Beach, Long Island, which I trapped on its nest on May 10, 1941 at Shinnecock Bay about 39 miles east of where it was hatched; one banded on July 13, 1941 at Penn Yan, New York, which was trapped over its young on July 7, 1943 at Long Point Beach, Ontario, Canada, about 150 miles west of where it was hatched. Of birds banded by others since 1956 one male banded as young, June 22, 1957 at Tobay Beach, Long Island, was trapped by me on its nest on May 29, 1958 at Moriches Bay, 41 miles east of where hatched.

#### NESTING

*Character of nest.* The nest is usually a slight hollow in the sand, but many times these hollows are lined with bits of shell. Occasionally one sees additional hollows in sand not far from the hollows in which the eggs are laid. I have not determined whether the hollow is made by the male or female or by both sexes.

*Replacement Nesting.* One brood is reared in a season, but if the nest or eggs are destroyed in the first half of the nesting season, the plovers will build another nest, not in the same place, but usually within 100 to 200 feet. There must be a few unmated birds in the area during the nesting season, as on a few occasions a male or a female had a second nest in the same year with a new mate, probably following the death of the mate of the first nest.

For example, a female was trapped on a nest on May 17, 1951 and a male, badly oiled on the breast, was trapped on the same nest the same day. The nesting was not successful. Then on June 21 the same female was trapped on a new nest 6,754 feet west of her earlier nest of the year. An unbanded male was also trapped on this nest the same day. The male of the first nest probably had died from the oiling.

On June 5, 1957 the beach road at Shinnecock Bay was freshly oiled and before the trucks could spread sand on top of this oil I observed two adult plovers alight in the oil with heavy accumulation on their feet and some smeared on their breasts. They alighted on their nest of three newly-hatched young, transferring so much oil that the young were dead three hours later, completely covered with oil.

*Change of Mates.* Of the 1,173 nesting adults that I have trapped, 288 have been retrapped, but only 39 pairs were mated together more than one year. Only two pairs remained mated for three years, the other 37 pairs for only two years (not always consecutive).

Adults that paired together one year after another nested nearer, on the average, to the nest site of previous years than a male or female that took on a new mate. The average distance between the nests of the same pair from one year to another was 204 feet, and ranged from two nests that were built in the same spot up to a maximum of 1,150 feet. On the other hand when a male or female took a new mate the following year, I found that they had moved a much greater distance than the previously paired birds. Of 120 males that took a new mate the average distance that a male moved from: the nest site of the previous years was 788 feet and ranged from eight nests that were built in the same spot up to a maximum of 8,600 feet.

Only 20 (16 per cent) of the 120 males moved more than 1,000 feet. Of the 103 females that took a new mate the average distance moved from the nest site of the previous years was 4,077 feet and ranged from

six nests that were built in the same spot up to a maximum of 82,368 feet. Fifty-one (50 per cent) of the 103 females moved more than 1,000 feet.

It would thus seem that the male exerts more influence in either choosing the nest site or the nesting area, as we find that on the average a female when taking a new mate moves about four times the distance of a male that takes a new mate.

Change of mates is not limited to cases of the death of one bird. One male (38-135147) had four different mates in four years, although all four females were alive and paired in one year, 1940 (Table 6).

TABLE 6

ONE MALE AND HIS SUCCESSIVE MATES, THEIR CHANGES OF MATE AND OF NESTING SITE

1938	1940	1941	1942
♂ 1 ♀ A	♂ 1 ♀ B (♂ 5992, ♀ 6492)	♂ 1 ♀ C (♂ 350, ♀ 12,672)	♂ 1 ♀ D (♂ 72, ♀ 4737)
	♂ 3 ♀ A (♀ 5100)	♂ 3 ♀ A (♂ and ♀ 162)	
♂ 2 ♀ B			
	♂ 4 ♀ C		
	♂ 5 ♀ D		

The numbers in parentheses are the distance in feet that a male or female moved its nesting site from one year to the next recorded year.

#### EGGS

*Laying intervals and clutch size.* Eggs are laid with an interval of one day between layings, as May 1, 3, 5, 7. The usual clutch is four eggs. Of 526 nests examined by me, 448 contained four eggs, 70 contained three eggs, and eight contained two eggs. Some of these nests with only two or three eggs may have contained a greater number before I found them, as I have definite evidence that 15 nests contained fewer eggs later than when originally found.

*Egg Predators.* Loss of individual eggs I suspect may be caused by House Rats (*Rattus norvegicus*) or House Mice (*Mus musculus*). House Mice can easily take an egg, as they commonly gnaw through the hard shell of eggs of our Pekin Ducks to eat the contents.

Common Crows (*Corvus brachyrhynchos*) ate the eggs out of two nests, Red Fox (*Vulpes fulva*) took the eggs from one nest, Opossum

(*Didelphis marsupialis*) took the eggs from one nest, three nests were destroyed by Army truck, car and tractor, and several nests by fishermen. One plover egg was slightly cracked while I marked it with pencil and one egg was cracked by an adult plover as it was trapped on its nest—the only two so damaged. Both were removed from the nests within a few days by the nesting plovers.

*Appearance, Dimensions and Weight.* The eggs are of some shade of light buff, evenly and sparsely marked with fine spots of blackish brown, sometimes with a few larger spots of pale grayish. The average weight of 35 fresh eggs was 9.6 grams and ranged from 8.5 to 10.7 grams. The average dimensions in millimeters of 26 eggs were 25.1 x 31.7 and ranged from 24.1 x 29.7 to 25.4 x 34.3. The last egg of the clutch tends to be the longest, and often the widest and heaviest. Weights and measurements in millimeters of eggs in order of laying from six nests are given in Table 7.

TABLE 7  
WEIGHTS AND DIMENSIONS OF SIX FRESH CLUTCHES

	Grams	Millimeters		Grams	Millimeters
1	9.8	24.6 x 31.7	1	9.8	25.4 x 32.5
2	10.0	24.8 x 31.7	2	9.7	25.4 x 30.9
3	9.8	24.8 x 31.2	3	9.7	25.4 x 31.7
4	9.8	24.8 x 31.9	4	9.7	24.8 x 32.5
1	9.5	24.6 x 31.2	1	9.9	24.6 x 31.7
2	9.5	24.6 x 30.2	2	9.9	24.8 x 31.7
3	9.3	24.1 x 29.7	3	9.3	24.1 x 31.7
4	9.3	24.1 x 31.2	4	10.0	24.8 x 32.2
1	10.0	24.1 x 32.5	1	8.5	—
2	10.3	24.6 x 32.5	2	9.8	25.4 x 30.9
3	10.5	24.6 x 32.5	3	9.8	25.4 x 31.7
4	10.7	25.4 x 32.5	4	10.0	25.4 x 32.5

*Egg Dates.* The earliest date for a complete set of four eggs in my area was April 26, 1949. The latest date for a set of eggs was July 23, 1950. I believe incubation may start in some nests with the laying of the third egg. On four nests I started trapping when the nests contained three eggs each and the males were trapped on each nest. These nests later had four eggs each.

#### INCUBATION

Both sexes incubate. I have never checked one nest for an entire day to determine the relative participation of male and female in incubation. The fact that in 206 nests, of the first bird to be trapped

on the nests, 104 were females and 102 were males, would seem to indicate that incubation was about evenly divided. In these cases I trapped both sexes on the nest the same day.

Incubating birds usually leave the nest by walking away when one approaches to within about 200 feet. A few will allow closer approach than this, especially one female that let me get to within 40 feet before she left the nest.

*Incubation Period.* Out of fourteen nests checked daily the incubation period was 27 days for five nests, 28 days for five nests, 29 days for two nests, 30 days for one nest and 31 days for one nest. Incubation periods vary with eggs from different females as well as with the length of time birds are kept off of their nests by intruders, such as fishermen and bathers (Wilcox, 1939: 7). Incubation periods were computed from the laying of the last egg to the hatching of the last egg.

#### HATCHING SUCCESS

612 young hatched out of 668 eggs laid in 174 nests that were checked from 1937 to 1958—a 91 per cent hatching success. This was an average of 3.83 eggs laid per nest and 3.52 young hatched per nest.

#### YOUNG

*Hatching.* In the large majority of nests the eggs in the same nest apparently hatch the same day, but there is usually a period of several hours between hatching of the first and last eggs. I will often come upon a nest where one or two dry young are 10 to 25 feet from the nest, one will be wet in the nest (just emerged), while an egg will be in the last stages of hatching and the young will not be out of the egg for another three or four hours (Plate 4).

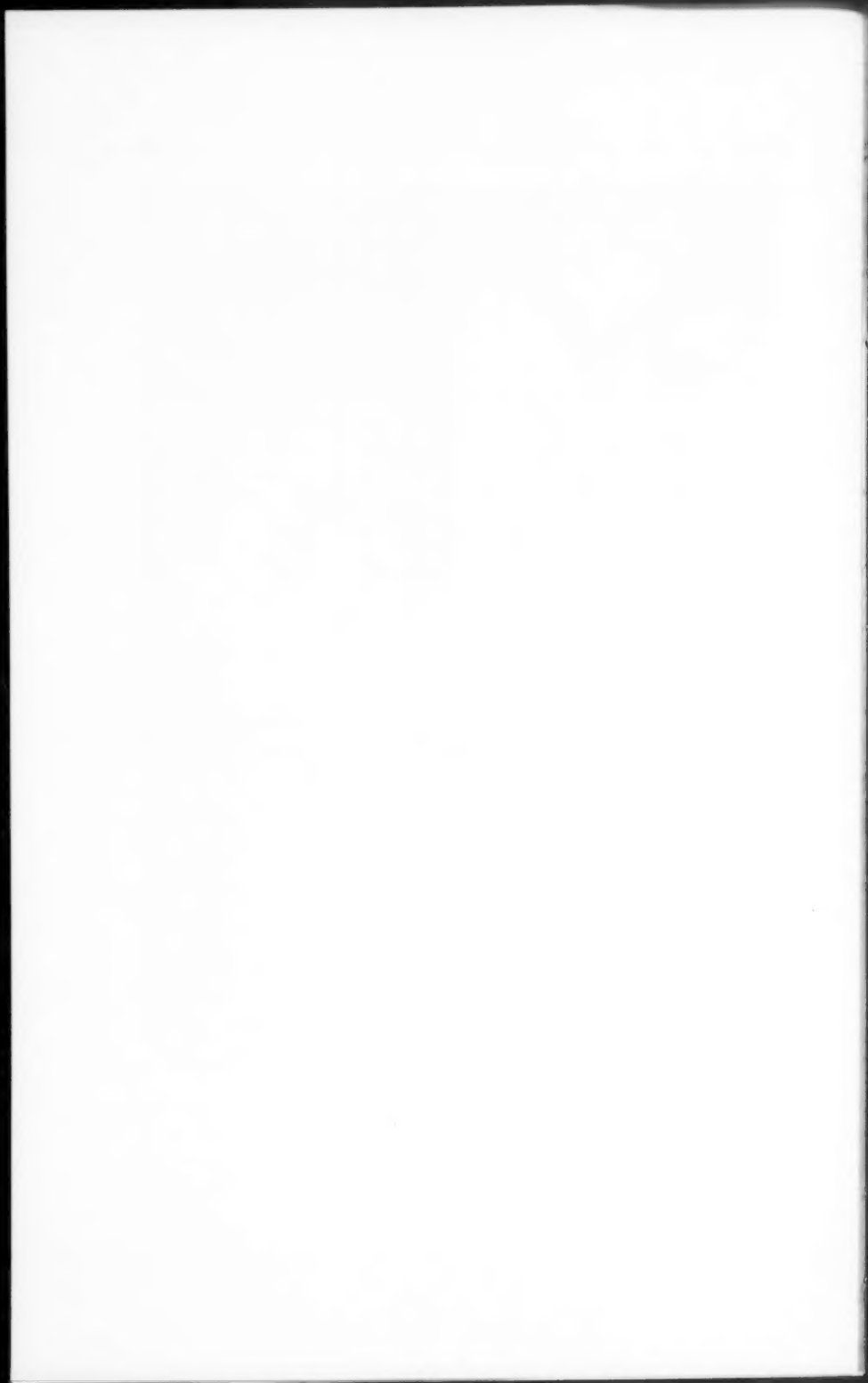
On May 30, 1940 there were two young and two pipped eggs in one nest at 3 P.M.; and the next day there were three young in the nest at 3 P.M. On July 20, 1950 there were two young and one pipped egg in a nest at 4 P.M. I went back to the car for bands without touching the two young and within four minutes I was back at the nest and found the two young 75 feet from the nest. The next day at noon the pipped egg had just hatched and this chick was the only one in the nest.

*Behavior of Young.* The individual young leaves the nest within two or three hours, as soon as its down is dry. The young are able to fly when thirty to thirty-five days old. Until the time of flight the young remain within 400 to 500 feet of the nest (although they do not return to it after hatching), despite miles of beach on either side of the nest area where they could wander.

When approached, young will crouch on the ground, their color blending with the sand. Some birds will hold this posture until they



Piping Plover (*Charadrius melodus*) on Long Island, New York. (Above left) one year old male with full belt, June 6, 1951. (Above right) Female with full belt, May 19, 1956. (Middle left) Male (44-103561) 5 years old, May 30, 1955. Belt is intermediate (markings on throat are oiling). (Middle right) Same male (44-103561) when 2 years old, June 12, 1952, showing a quarter inch white gap in belt. (Below) Nest with three newly hatched young and egg, June 29, 1957. (Photos. by L. Wilcox.)



are touched or almost touched. Then they run with remarkable rapidity. I timed one downy young two days old and it ran eighty-one feet in twelve seconds, a rate of 4.6 miles per hour. A ten day old bird ran one hundred eighty feet in twenty-six seconds, or 4.7 miles per hour. Usually after running some distance they crouch again, disappearing in the background. If forced, they can swim readily. A five day old bird swam fifty feet out into the bay to escape capture and then came ashore.

Several times I have observed adults knock down young while the young were running away from me. The young remained motionless on the sand as soon as the adults did this. Presumably the adults realized, before the young, that they were safe from their enemies if they remained still on the ground.

It is astonishing how well the young blend into their surroundings if they remain motionless, even right out in open sand. Sometimes it takes me minutes to find all four young of a nest after they have stopped running. Many times I cannot locate all of them the first time, so I retire to let the adults come up to them; then the young will start walking again.

*Brooding.* Adults brood the young in some cases until they are twenty days old. It is thus still possible to trap adults even after the eggs have hatched by catching the entire brood of young and then tying one young to a stake in the ground and setting a trap, which takes the adult as it comes to brood.

*Hatching Dates.* The first young of each year were usually found during the last week in May. My earliest date for first young is May 24, 1949 and latest date for first young, June 5, 1948. My latest dates for young in a nest ranged between July 14, 1948, and July 24, 1950. My latest date for an incubating bird was a nest of three eggs found on June 25, 1941, on which I found a bird still incubating on July 16, July 28, and August 6. This nest was deserted on August 13 and, upon examination, the eggs proved to be infertile. This same pair had had a previous nest in the same year on May 16, located 144 feet east of the second nest, and four young had hatched on May 31. The fact of a second nesting in the same year may indicate that the young had died or been killed.

*Color of Soft Parts.* Two-day-old young have legs and toes flesh color, basal third of bill dark brown and balance of bill black. Twenty-five day old young have flesh colored legs, dusky, almost black bill, and dark brown iris. Thirty day old young have flesh colored legs and entirely black bill. The adult male has basal half of bill orange with rest of bill black, and legs the same orange as the bill.

TABLE 8  
DATES OF FIRST AND LAST YOUNG FOUND IN NEST

First Young Found				Last Young Found
May 25, 1937	May 29, 1942	May 24, 1949	June 4, 1954	July 21, 1940
May 26, 1938	June 1, 1944	May 31, 1950	May 30, 1955	July 21, 1941
May 30, 1939	May 25, 1945	May 29, 1951	May 30, 1956	July 23, 1947
May 30, 1940	May 31, 1947	May 31, 1952	May 30, 1957	July 14, 1948
May 25, 1941	June 5, 1948	May 28, 1953	May 31, 1958	July 24, 1950

*Weight and Dimensions.* Day-old young weighed 6.8 grams; 7 days old, 8.5 grams; 10 days old, 12.4 grams; 14 days old, 17.0 grams; 21 days old, 25.7 grams; 29 days old, 29.4 grams. Two young 23 days old had wing lengths of 61.9 and 65.0 millimeters. One young 26 days old had a wing length of 73.1 mm. and tail 25.4 millimeters.

#### DEFENSE AGAINST OTHER SPECIES AND INJURY FEIGNING

Adults defend their nest territory and young from other species. On June 8, 1939, a Robin (*Turdus migratorius*) was feeding on the ocean beach 75 feet from two young plovers and the adults chased it, driving it away. I have also seen them give chase to Herring Gulls (*Larus argentatus smithsonianus*) and to Great Black-backed Gulls (*Larus marinus*) flying low over their young.

Some males and females feign injury at least a week before the eggs hatch, to draw intruders away from their nests (see Cruickshank, 1939: 17). One female feigned injury two weeks before the eggs hatched. On June 8, 1950, one male plover feigned injury to an adult Least Tern (*Sterna albifrons antillarum*) nesting near the plover's nest. On June 1, 1951, a Least Tern nest was only four feet from a plover's nest. The Least Tern was most aggressive and repeatedly chased the plover away as it attempted to get back to its nest. On June 8, 1939, while I was hiding in the car and watching with binoculars a female approach its nest, the male feigned injury as soon as the trap dropped over the female on the nest. The male was about 25 feet from the nest. On June 4, 1940, a female did not fly when I released her on the ground but simply ran away, then when 50 feet from me she feigned injury.

#### LONGEVITY

Attached are tables (9 and 10) showing the various years after initial banding in which Piping Plovers were retrapped by me. Table 11 shows ages. In the case of those banded as young birds (22 males, 25 females), I know their exact age (within a few days) when they

TABLE 9  
RETURNS ON NESTS OF BIRDS ORIGINALLY Banded AS ADULTS

Year	'37	'38	'39	'40	'41	'42	'43	'44	'45	'46	'47	'48	'49	'50	'51	'52	'53	'54	'55	'56	'57	'58
1937	12																					
1938	6	29																				
1939	3	3	37																			
1940	2	11	10	82																		
1941	3	8	8	19	75																	
1942		2	4	14	29	42																
1943*				4			2															
1944			2	4	5	5	2	53														
1945*							2		3													
1946*								5														
1947					2	1		3			43											
1948					1	1					13	44										
1949					1	1					4	11	62									
1950					2	1		1			6	7	18	57								
1951					1						1	2	5	10	28							
1952											1	2	2	7		17						
1953											2	2	1			3	12					
1954											2	1				1	2	7				
1955												1		5	2	1	1	3	20			
1956														2	1	2	2	1	4	17		
1957											1			1	2	1	1	1	1	6	45	
1958														5					1	3	21	57

The first number in each column (reading vertically) represents birds banded as adults on nests in that year; the numbers below show how many of these were retrapped on nests in the succeeding years indicated on the left hand column. (For birds originally banded as young and thereafter trapped as adults, see Table 10).

Not included as returns in this table are 6 birds banded as adults on nests, known to have been collected or found dead in the nesting area: banded June 9, 1950, Moriches; collected Moriches July 31, 1954; banded June 3, 1959, Moriches, found dead Moriches May 24, 1940; banded June 3, 1939, Moriches, found dead Moriches May 13, 1942; banded May 17, 1941, Shinnecock, found dead Shinnecock June 2, 1944; banded May 19, 1944, Moriches, found dead Moriches April 3, 1948; banded May 31, 1947, Shinnecock, found dead Shinnecock June 24, 1948.

\* As a result of gasoline limitations during war years, very little trapping was done in 1943 and 1945 and none in 1946.

TABLE 10  
RETURNS ON NESTS OF BIRDS ORIGINALLY BANDED AS YOUNG

Year	'36	'37	'38	'39	'40	'41	'42	'43	'44	'45	'46	'47	'48	'49	'50	'51	'52	'53	'54	'55	'56	'57	'58
1936	1																						
1937		21																					
1938		1	42																				
1939		1	2	42																			
1940		2	2	2	98																		
1941	1		1	1	3	162																	
1942	1		1	1	4	1	101																
1943*			1																				
1944	1			1	1			38															
1945*									3														
1946*																							
1947						1	1		1			85	46										
1948						1							1	62									
1949						1							3	1									
1950												2	1	2	3	60							
1951												2		1	3	25							
1952												1		1	1	16	2						
1953												1		1	1	1							
1954														3	1	1							
1955														1	1	1							
1956														2	1	1				20	25		
1957												1		1	1						1	46	
1958												1		1						1	1	3	71

The first number in each column (reading vertically) represents the birds banded as young on nests in that year, and the numbers below show how many of these were retrapped on nests as adults in the succeeding years indicated on the left hand column. (For birds originally banded as adults, see Table 9.) Not included as a return in this table is one bird banded as young June 13, 1947, at Shinnecock, known to have been collected at Moriches, August 28, 1954.

\* As a result of gasoline limitations during war years, very little trapping was done in 1943 and 1945 and none in 1946.

were retrapped. In the case of birds originally trapped as adults (117 males and 124 females), I know only the minimum age at the time of retrapping, and this is indicated by the use of +. For example, "2+" indicates that the bird was adult when first trapped, say in 1956, and caught again as a return in 1957, by which time it must have been at least two years old, but possibly much older.

TABLE 11  
AGE ON LATEST RECOVERY (TO JULY 1958)

<i>Banded as Young (47)</i>			<i>Banded as Adult (241)</i>		
<i>Years Old</i>	<i>Males</i>	<i>Females</i>	<i>Years Old</i>	<i>Males</i>	<i>Females</i>
1	6	7	2+	48	71
2	2	9	3+	20	22
3	1	5	4+	19	14
4	3	1	5+	14	7
5	3	1	6+	7	1
6	-	1	7+	3	4
7	3	-	8+	-	2
8	2	-	9+	3	2
9	1	-	10+	2	-
10	1	-	11+	1	1
11	-	1			
	22	25		117	124

A bird retrapped in more than one year is listed only under the age of latest recovery.

This table indicates that only 13 per cent of the females lived to be five years or older, while 28 per cent of the males lived to be five years or older. Twelve of my Piping Plovers achieved ages of from 8 to 11 years.

The banding returns of other North American shorebirds are so scanty that age records probably have little significance. Such returns show the oldest to be: American Woodcock, 8 years, Spotted Sandpiper, 7 years, Killdeer, 6 years, Upland Plover, Avocet, and Least Sandpiper, 5 years.

In my opinion, many shorebirds lose their bands by the abrasive action of sand after about 5 years. Many of my Piping Plovers had to be rebanded after 4 or 5 years. One male only four years old had the band worn so thin when retrapped that it was ready to come off. I would recommend that a thicker or more durable band be used for shorebirds in order to obtain more reliable longevity records.

#### MORPHOLOGY OF ADULTS

*Sexual differences.* The sexes of a known pair can be distinguished in about 95 per cent of the cases (all nesting pairs) by plumage alone. When both adults are caught together and compared, the males ap-

pear to have larger bills and a broader black band on the forehead. The sex of individual adults can be determined by examination of the cloaca, and often by call notes. I found that the sex of a majority of the adults could be told by note. The call note of the female is shriller or higher pitched than that of the male.

*Age differences.* Almost all one-year-old birds were lighter in weight; their wings and tail were shorter and the black patches or ring on the foreneck and the black bar on the forehead were lighter in color than in older birds.

*Weights.* The average weight of 49 breeding males was 54.9 grams and ranged from 46.5 to 63.7 grams. The average weight of 38 females was 55.6 grams and ranged from 46.4 to 62.3 grams. With most birds there was a slight increase in weight with age. A male weighed when four years old 53.0 grams, when five years old 56.0 grams, and when eight years old 56.8 grams. A one-year female weighed 53.7 grams.

*Measurements.* The mean wing length of 134 males was 117.3 mm. and ranged from 111.2 to 122.1 mm., with only 5 per cent under 114.3 mm. and 20 per cent 120.6 mm. or more. I believe those with wings under 114.3 mm. were one year old birds. A male had the wing 114.3 mm. when one year old, 115.8 mm. when two years old, 114.3 mm. when three years old and 117.3 mm. when six years old. The mean wing length of 126 females was 117.0 mm. and ranged from 109.3 to 122.1 mm., with 11 per cent under 114.3 mm. and 17 per cent 120.6 mm. or more. A one year old female had 112.7 mm. wing, 115.0 mm. when two years old and 118.3 mm. when four years old.

The mean tail length of 98 males was 51.3 mm. and ranged from 41.1 to 54.6 mm., with 15 per cent under 50.8 mm. and 18 per cent that were 53.3 mm. or more. A one year male had 41.1 mm. tail, 53.8 mm. when two years old, 50.8 mm. when three years old and 50.8 mm. when six years old. The average tail length of 97 females was 50.5 mm. and ranged from 45.9 to 55.8 mm., with 29 per cent under 50.8 mm. and 10 per cent that were 53.3 mm. or more.

#### STATUS OF THE "BELTED" PIPING PLOVER (*Charadrius melodus circumcinctus*)

After the A.O.U. Committee on Classification and Nomenclature reinstated *C. m. circumcinctus* as a recognized subspecies (1945: 440), I began in 1948 to take notes and measurements (and in the later years photographs) of the extent of the black band on the foreneck of all adults trapped. The subspecies *circumcinctus* is supposed to be characterized by a solid black band across the neck, whereas the

nominate subspecies has black only on the sides of the neck and a pure white gap across the front. The A.O.U. Check-list (1957: 167) gives the breeding range of *circumcinctus* as from central Alberta to the southern shores of Lakes Michigan, Erie, and Ontario, while the populations from the coastal beaches extending from southeastern Quebec and southwestern Newfoundland to Virginia are regarded as typical *melodus*. Birds from the Great Lakes, though listed as *circumcinctus*, are stated to be intermediate.

*Proportion in population.* Of 586 nesting adults trapped by me from 1948 to 1958, 104 (18 per cent) were fully belted, 233 (40 per cent) were intermediate, and 249 (42 per cent) had a pure white gap (Table 12). Birds were regarded as fully belted where there was a complete and wide black band, as intermediate if there was a connecting band but it was light in color or broken (Plate 3). A full belt appeared in a considerably larger proportion of males (27 per cent), and in only about 8 per cent of females. This may reflect the tendency toward some reduction in blackness in females.

TABLE 12  
TYPES OF CHEST BANDS 1948-1958

Sex	No.	Fully Belted	Intermediate	White Gap
Males	295	81	104	110
Females	291	23	129	139
Total	586	104	233	249

Griscom and Snyder (1955: 88-89) indicate that all three "types" are also found breeding in coastal Massachusetts. Ludlow Griscom has informed me (*in litt.*) that he estimates that about 20 per cent of the Piping Plovers breeding in New England are fully belted.

*Measurements.* Measurements of the three plumage types trapped in my area show no appreciable differences (Table 13).

TABLE 13  
WING AND TAIL MEASUREMENTS IN MILLIMETERS OF THE THREE PLUMAGE TYPES

Wing						
	Number	Males Range	Mean	Number	Females Range	Mean
White gap	51	111.7-122.4	117.6	69	109.4-122.1	116.3
Intermediate	44	111.2-123.9	116.8	53	109.3-122.1	116.8
Belted	29	113.5-120.6	117.0	7	111.7-120.6	114.8
Tail						
White gap	51	48.2-54.6	51.5	69	45.9-55.3	50.2
Intermediate	44	47.7-53.8	51.3	53	45.9-55.3	50.8
Belted	29	47.5-53.8	51.3	7	45.9-52.2	50.5

Moser (1942) also states he found no mensural differences in the three plumage types from various areas.

*Pairings.* The pairings of 266 males (68 fully belted, 118 intermediate, 80 white gap) with various types of females are shown in Table 14.

TABLE 14  
PAIRINGS OF THE THREE PLUMAGE TYPES 1948-1958

No.	Males	Full Belt	Females	White Gap
	Type		Intermediate	
68	Full Belt	7	32	29
118	Intermediate	10	64	44
80	White Gap	4	41	35
266		21	137	108

*Young of Known Parentage.* The belted or non-belted condition shows up in the young birds as soon as they have acquired the juvenal plumage. There is some tendency for the band to become more solid with age (Plate 4). Table 15 shows the plumages of 13 young from known parental types.

TABLE 15  
THIRTEEN YOUNG FROM PAIRINGS OF THE THREE PLUMAGE TYPES

Age in Years	Young	Male Parent	Female Parent
1 ♀	3/4 inch white gap	Full belt	1/2 inch white gap
1 ♀	1/2 inch white gap	Light connecting ring	Medium connecting ring
1 ♀	5/8 inch white gap	Full belt	3/4 inch white gap
1 ♀	Almost pure white gap	Medium connecting ring	Light connecting ring
1 ♂	Full belt	Full belt	Light connecting ring
2 ♀	1/2 inch white gap	1/4 inch white gap	Intermediate
2 ♀	3/4 inch white gap	Medium connecting ring	3/4 inch white gap
5 ♂	Almost pure white gap	Faint connecting ring	Faint connecting ring
5 ♀	Intermediate	Full belt	1/2 inch white gap
5 ♂	Medium connecting ring	Full belt	3/8 inch white gap
1 ♂	1/4 inch white gap	Medium connecting ring	1/2 inch white gap
1 ♀	Light connecting ring	Medium connecting ring	Light connecting ring
2 ♂	1/2 inch white gap	Light connecting ring	1/2 inch white gap

*Discussion.* The facts available raise a serious question as to the validity of the subspecies *circumcinctus*. This form has had a checkered career since it was described from Nebraska by Ridgway in 1874. It was rejected by the third and fourth editions of the A.O.U. Checklist, and by Ridgway himself in his final work (1918: 131). Its revival (A.O.U. Committee, 1945: 440) was stated to be based on the papers of Moser (1942), pointing out that museum specimens indicated almost all birds breeding in the Mississippi Valley to be of the belted type,

and of Burleigh (1944: 367-368), reporting the same situation as to winter specimens on the central Gulf Coast. The assumption seems to have been that belted birds reported from the Atlantic coast were primarily migrants. While it is likely that the relative percentage of one type or another may vary geographically, the number of breeding belted birds on the Atlantic coast makes it illogical to distinguish belted individuals as a separate race.

The larger proportion of belted individuals in the Mississippi Valley may indicate a greater concealing value from the disruptive effect of a full belt (Huxley, 1958) in the interior habitats. These, judging by the photographs and description of the Nebraska habitat (Moser, 1942), appear to consist of coarser sands, mixed with pebbles and dark mussel shells, which produce a darker and less uniform background than the Long Island coastal beaches (*cf.* Nichols 1939).

#### ACKNOWLEDGMENTS

I am indebted to C. K. Nichols and to the late J. T. Nichols for helpful advice in regard to this study and to Dean Amadon and Eugene Eisenmann for suggestions as to this report.

#### SUMMARY

From 1937 to 1958 the writer banded 744 adult and 979 young Piping Plovers. Adults were trapped on 645 nests. There were 433 returns out of 1,723 banded. Out of 979 young banded only 47 returned to nest in the 17 to 22 mile strip where they were hatched.

Nesting Piping Plovers usually return to nest in the area where they were first caught nesting. Out of the 1,173 adults trapped only 39 pairs remained mated from one year to another (37 pairs for only two years and 2 pairs for three years). When the same individuals remained paired the distance of their nest from that of the previous year averaged only 204 feet. 120 males that took on a new female moved an average of 788 feet from one year to another. 103 females that took a new mate moved an average of 4,077 feet from one year to another.

Piping Plovers arrive on the nesting grounds on Long Island the last week in March. The incubation period is 27 to 29 days. 85 per cent of the nests contained 4 eggs. Eggs are laid every other day and weighed when fresh an average of 9.6 grams each. Earliest date for a set of 4 eggs was April 26, 1949. Latest date for a set of (addled) eggs was July 23, 1950.

Day-old young weigh about 6.8 grams and leave the nest soon after hatching. Young are able to fly when thirty to thirty-five days old.

They remain within 400 to 500 feet of the nest until time of flight. 612 young hatched out of 668 eggs laid in 174 nests. Escape behavior of downy young is discussed.

The average weight of adult males was 54.9 grams and of adult females, 55.6 grams. Mean wing length of males was 117.3 millimeters and of females was 117.0 millimeters. Mean tail length of males was 51.3 millimeters, and of females was 50.5 millimeters. Other morphological sex and age characters are given.

Six Piping Plovers lived to be at least 9 years old, three at least 10 years old, and three at least 11 years, the oldest North American shorebirds recorded to date. The nearest is an 8 year old American Woodcock.

Though supposed to belong to the typical race *C. m. melodus*, of the nesting Long Island Piping Plovers 18 per cent are fully "belted," corresponding with the interior race, *C. m. circumcinctus*. Data on pairings of the various plumage types, as well as the appearance of their progeny are given. The validity of *C. m. circumcinctus* is questioned.

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*Speonk, Long Island.*

## THE WIDEAWAKE CALENDAR, 1953 TO 1958

BY JAMES P. CHAPIN AND LEONARD W. WING

In "The Calendar of Wideawake Fair" (Auk, 74: 1-15, 1954), the senior author presented evidence, based on eleven years of records, showing that on Ascension Island in the Atlantic ( $7^{\circ}57'S$ ,  $14^{\circ}22'W$ .) the Sooty Terns, *Sterna fuscata*, (locally called "Wideawakes" because of their nocturnal noisiness), breed at intervals of about 9.6 months. This is very different from the cycle of the same species at other localities studied, where individual birds, so far as known, have an annual breeding cycle.

After he read that report it occurred to the junior author that 292.6 days (or 9.61 months of our calendar) are all but equivalent to ten lunar months (295.3 days). Might not the moon in some way or other serve as the regulator of the breeding cycle of *Sterna fuscata* at Ascension Island? At about the same time Dr. Charles Hetzler wrote from Brown University to Dr. R. C. Murphy pointing out the same correlation.

Meanwhile the senior author, residing for several years in Africa, continued his efforts by correspondence to secure records of each successive nesting period of the Wideawakes on Ascension.

In the present report our aims are twofold:

(1) to continue the calendar of Wideawake Fair from the end of the year 1952 through the year 1958, during which period its regularity is just as surprising as in the preceding decade; and

(2) to discuss the likelihood that each tenth period of bright moonlight inaugurates a new period of reproduction and thus serves as the "regulator."

### DATA FOR 1953-1958

The information collected since 1952 indicates that the intervals between nestings on Ascension are close to 9.7 months (fig. 1).

Frequent changes in European personnel by Cable and Wireless, Ltd. (our main source of information in Ascension) and the fact that Wideawake eggs are laid only at some little distance from the cable station of Georgetown offered difficulties in obtaining exact dates for the very first eggs. A check is often provided by the applications of St. Helenians employed in Ascension for export licenses to cover small shipments of the fresh eggs to their friends on St. Helena. Applications are never made before some eggs have become available, and so the dates of the licenses are always a few days later than the laying of the first eggs by Wideawakes.

1953: There are excellent reasons for believing that a new season of oviposition began on schedule about 9.7 months after the start of the one in April, 1952, that is to say in the middle of February, 1953. The first application for the export of

eggs was dated February 23rd, as Chapin was kindly informed by J. R. Bruce of Cable and Wireless. On April 7, 1953, Harry A. Franck, an old friend, called at Ascension and found the Wideawakes still had lots of eggs. The last application for the export of eggs was dated April 21st.

1954: F. J. Atkins of Cable and Wireless wrote that although he personally had not noticed any Wideawakes flying about in December of 1953, the first request to export eggs was dated January 4, 1954. Laying must have commenced before New Year's Day. In May of 1954 all the Sooty Terns took their departure from the "Fair."

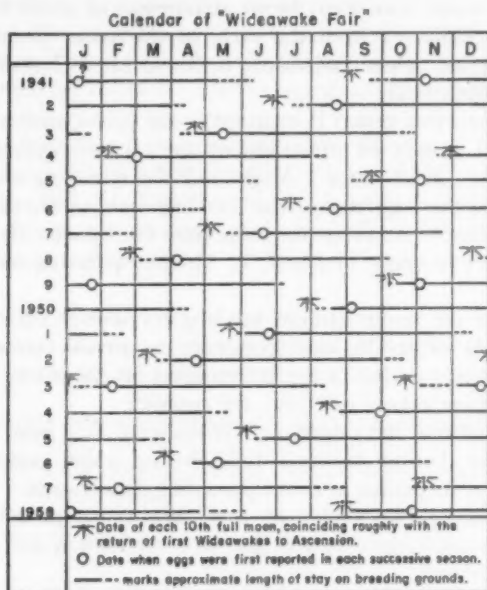


FIGURE 1. Calendar of nesting by *Sterna fuscata* on Ascension Island 1941-58.

By the first day of September, 1954, a few terns were again noticed; and on September 30th one of the English staff found a single egg, doubtless one of the first laid. By the end of November chicks were numerous on the ground. On January 24, 1955, many of these were half-grown, still short-tailed; and by March 17th most of the terns had departed.

1955: Later in the year F. J. Atkins reported that on July 23rd a St. Helenian collected three dozen Wideawake eggs, so laying must have begun a week or more previously. Yet the first license to export eggs was granted only on August 8th of that year. The terns had probably all left by mid-January of 1956.

1956: During the year of 1956 J. R. Bruce wrote Chapin that new eggs were again reported on May 13th. Returning Wideawakes had first been heard on April 10th, and by the end of November 1956 none remained about Ascension Island.

1957: It was in mid-January that the terns began to be heard again, and their first eggs were found in mid-February, Mr. Bruce informed Chapin. At the beginning of August some of the young could fly, others could not, and a few eggs were still to be seen. By the end of September all the terns had left.

In early October, 1957, Bernard Stonehouse and Philip Ashmole, advance members of the B. O. U. Centenary Expedition, arrived at Ascension to conduct a detailed study of its avifauna. In the last week of October, they reported to Chapin, the Wideawakes began circling the breeding grounds night after night. By November 16th Ashmole was able to take a flashlight photograph showing numbers of the birds sitting close together on the ground where later they would breed.

1958: On the basis of his long series of records, Chapin had expected egg-laying to begin in December 1957; but it was only on January 2, 1958, that Ashmole finally found his first egg. The date was kindly telegraphed to Chapin by J. E. Packer of Cable and Wireless. The members of the B. O. U. Expedition were to make a protracted stay on Ascension Island and thus were on hand for a second breeding period of Wideawakes in 1958. This we expected to start in the second half of October; Ashmole found that the first egg was laid about October 25th.

#### DISCUSSION

When the records of the past six years are added to the diagrammatic calendar published in 1954, they emphasize the impressive regularity exhibited during the previous eleven years. At the base of this striking behavior, we feel, there must be a strongly developed physiologic cycle of some 9 to 10 months in the birds themselves. The extremely tight social bond so characteristic of every population of *Sterna fuscata* throughout the warm oceans of the world would tend to keep breeding on any particular island closely synchronized. But wherever there is any marked seasonal change, terns of this species normally come back to begin laying again at intervals of 12 months, not 9.7 months, as we now find the average period to be at Ascension. This island is exceptional in that any month of the year is favorable for nesting by *Sterna fuscata*. In most other places the birds may have to wait till 12 months elapse; not so at Ascension. Elsewhere the annual change would seem to act as the regulator of the terns' inner cycle.

Now for the correlation with the moon: the close relationship of the breeding cycle of Wideawakes at Ascension with the period of 10 lunar months, as pointed out by the junior author, suggests that on Ascension one period of brilliant moonlight in every ten must have a decisive influence in regulating a strong physiologic cycle. How might it work?

Residents of the island have long known that for six weeks or more before any eggs were to be found in the "fairs" the sooty terns would

again be heard flying about during the night. Hence the popular name of "Wideawake." Soon they would be seen to come in and settle on the ground toward dusk, and to pass the night there. This is just the time when a bright moon, near the full, should encourage them most effectively to reoccupy the nesting grounds, to court, form pairs, and prepare for oviposition. There would be another period of bright moonlight, to be sure, before many eggs had been laid; but after that the production of eggs, incubation, and gathering food for chicks are all going ahead regardless of the phases of the moon. Only that period of full moonlight when the terns are gathering around the island, and have again the urge to settle on the traditional breeding grounds during the night, would seem really to act as "regulator." It could do so only because of the birds' well-defined internal rhythm and the extremely strong social bond.

On the calendar offered in Figure 1, which extends from 1941 to 1958, the dates of full moons that preceded the first eggs by a month or more are indicated. All these are in a regular series of 10th full moons, the ones that would seem to encourage the Wideawakes to reoccupy their nesting areas.

To test the cycle of ten lunar months, we append Figure 2, a time chart used for initial measurements of possible cycle-length in a time series. It is rather well suited to a record that gives only dates of occurrence but no amplitude, as in the egg-laying dates of the Wideawakes.

Across the top, the time chart has intervals that are the length of the cycle being tested, in this case ten lunar months or 9.7 calendar months (actually 9.702 months),

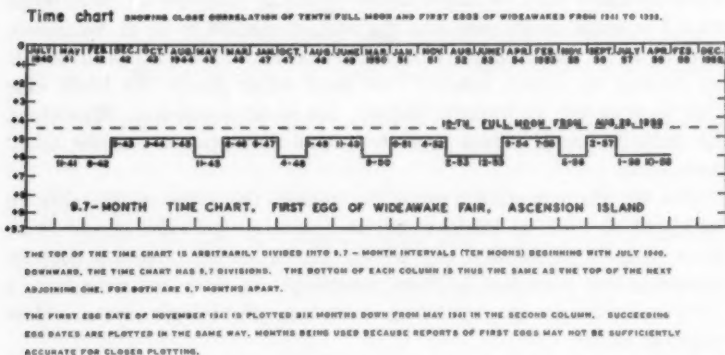


FIGURE 2. Correlation of cycle of ten lunar months with commencement of egg-laying by *Sterna fuscata* on Ascension, 1941-1958.

beginning arbitrarily with July 1940. Downward, the time chart has 9.7 positions in each column. The bottom of each column is therefore 9.7 months from the top, as are also the respective tops of the succeeding columns. Because of the general problem of preciseness in getting the exact date of first eggs, the egg dates are plotted by months of occurrence. This appears to be as close as presently possible. The first egg date, that of November 1941, is plotted at six months down from the base of May 1941, at position six in the second column. Succeeding egg dates are plotted in the same way, the plottings forming a band across the time chart. It is the forming of a band that indicates the presence of a cycle.

It is not inconceivable that in the warm Atlantic Ocean around Ascension there might be some cyclic change affecting the supply of small fish, upon which the Wideawakes feed exclusively. But thus far no oceanographer has called our attention to any such cycle of 10 lunar months. Even if every tenth period of brilliant moonlight is the "trigger" or the "regulator" of the Wideawakes' cycle of reproduction it would seem strange that the birds might not occasionally "slip a cog" and make a new start only after eleven lunar months. Certainly nothing of that sort has occurred during the last sixteen years, although such a slip may well be expected at any time in the future.

Is the case of the Wideawakes really so unique as has been said? It will not surprise us if the B. O. U. Expedition finds that other seabirds at Ascension such as noddies, boobies, tropic-birds, or frigate-birds, nest without paying any attention to our conventional calendar, at intervals that best suit their tastes and needs, presuming that their off-season time is spent where no seasonal change might serve as a control.

What do we really know of the reproductive cycles of many kinds of birds dwelling in the narrow belt close to the equator, where seasons are all but non-existent, especially in the rain forests of Africa and South America? Where there is no strong social bond or post-nesting movement, individual pairs of many bird species may be found nesting in such a region in any month of the year. When does any given individual cease breeding and molt—as of course it must—and how long a time elapses between successive periods of reproduction?

#### SUMMARY

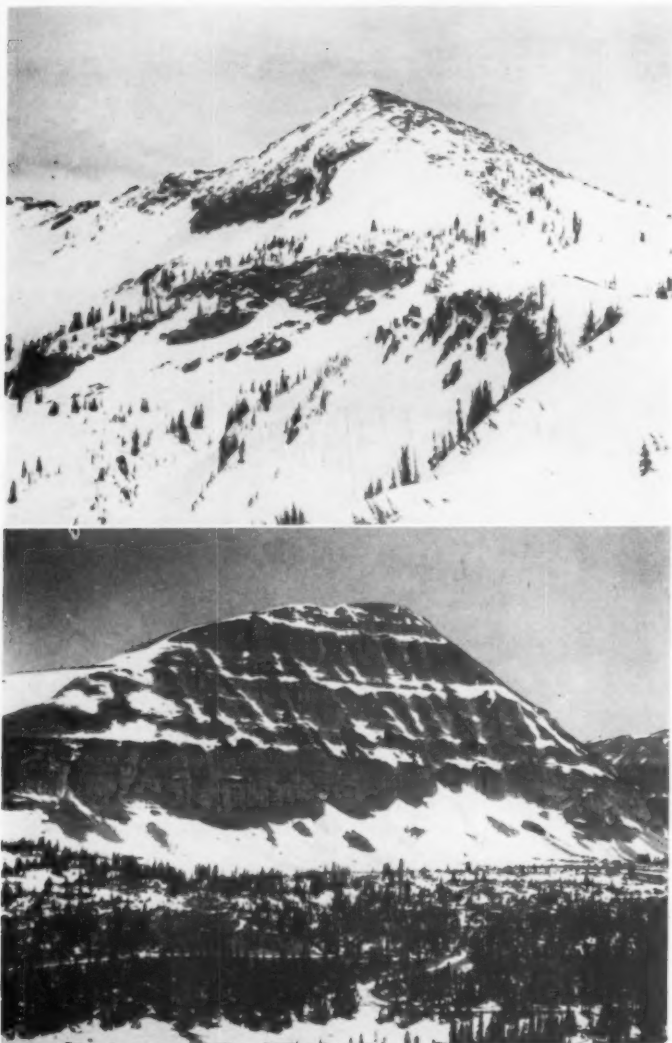
The Sooty Terns or Wideawakes (*Sterna fuscata*) of Ascension Island in the Atlantic (7° 57' South, 14° 22' West) since 1941 show a breeding cycle corresponding to the period of ten lunar months. This suggests an internal rhythm triggered or regulated by the night-activity of Wideawakes during the brightness of the tenth lunar

month. Egg-laying dates between 1953 and 1958 show that the birds have continued the breeding rhythm previously shown for 1941-1952. It is suggested that other non-annual rhythms may be expected of birds in the narrow equatorial belt where seasons are all but non-existent.

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This article is dedicated to Professor Erwin Stresemann on the occasion of his seventieth birthday.





Breeding habitat of the Black Rosy Finch (*Leucosticte t. atrata*). (Above) Condition above 10,000 feet elevation in the Wasatch Mountains of Utah in April, 1953, at the time of arrival of the birds on the breeding grounds. (Below) Cliff utilized for nesting by the birds. Bald Mountain, Uinta Mountains, Utah, June, 1953.

## LIFE HISTORY OF THE BLACK ROSY FINCH

BY NORMAN R. FRENCH

THE Black Rosy Finch, *Leucosticte tephrocotis atrata*, is a member of a genus of birds restricted in their breeding range to the high altitudes of the mountains of western North America and Asia. No previous intensive study has been made of this form. The North American rosy finches are usually considered three species (*L. tephrocotis* with several subspecies, *L. atrata*, and *L. australis*), because of their somewhat different coloration and their presumed allopatric distribution (A.O.U. Check-list, 1957: 564-566). The breeding range of the Black Rosy Finch, interposed between those of *L.t. tephrocotis* and *L.t. australis*, includes the mountains of Idaho, Montana, Utah, Wyoming and northeastern Nevada. During these studies, at least two regions of intergradation were found in the mountains of Idaho and Montana where populational interchange, with resulting mixing of characters of *L.t. tephrocotis* and *L.t. atrata*, occurs. Detailed distributional data have been presented in a separate paper (French, 1959), and the conclusion has been reached that all the American rosy finches should be treated as races of one species, *L. tephrocotis*.

The Black Rosy Finch is the only American *Leucosticte* showing strong sexual dimorphism. The male is sooty black, with a pink wash on the lateral parts of the body, especially intense on the wing and tail coverts, and with a light gray crescent extending from eye to eye over the back of the crown. The female is much duller, has the back and wings more brownish, the abdomen grayish, the head markings indistinct, and the pink wash paler, sometimes buffy or whitish.

During the breeding season the Black Rosy Finch is found only above timberline. This may be upwards of 9,000 feet in some mountain ranges, while in others birds breed only above 11,000 feet elevation. In the mountains inhabited there seems to be no upper altitudinal limit to the range. In winter Black Rosy Finches descend to lower elevations, being found in flocks from 7,000 feet down to at least 4,000 feet in valleys of southern Wyoming, western Colorado, Utah, Nevada, and adjacent parts of California, and New Mexico.

### STUDY AREA AND METHODS

Three summers, 1951, 1952, and 1953, were spent making daily observations of Black Rosy Finches in their breeding habitat in the Teton and Absaroka mountains of Wyoming and the Uinta Mountains of Utah. In addition, at least eight other mountain ranges were visited to observe and collect specimens. Winter observations and

banding were done mainly in the vicinity of Salt Lake City. A total of nearly three hundred rosy finches was banded, half of which were Black Rosy Finches.

#### BREEDING ACTIVITIES

From mid-February until the end of March on the wintering grounds near Salt Lake City in 1953, and again in 1954, increasing frequencies of fights between males occurred. These were short charges while feeding on the ground, or vigorous aerial chases. Although I once observed a male displaying before a female at a winter roost on March 15, 1953, it is doubtful that pairing takes place before the birds return to the breeding range. Rosy finches abandon their regular winter roosts near Salt Lake City before the end of March.

In 1953 Black Rosy Finches were observed on the breeding grounds at 11,000 feet elevation in the Wasatch Mountains of Utah on April 5. Bleak winter conditions still prevailed (Plate 5). Because of the wind, a male attempting to display before a female held his position in front of her with great difficulty.

Once on the breeding grounds the males attempt to attract prospective mates by displaying, chirping and following the females about. Only one male has been observed displaying to a female at any given time. A considerable amount of time is still spent by the birds feeding quietly in flocks. The female remains in proestrus until some time after the first of June. As the breeding season advances the males become more persistent in their efforts. With the approach of oestrus the females begin to take notice of the activities of the males. The female bird shows interest in the display of the male by either approaching him, watching all his movements carefully, or failing to retreat when he approaches. This activity, observed on several occasions, results in copulation, after which the pair begins search for a nest site.

*Display.*—The display of the male was observed only when a female was present. I have observed birds displaying on the ground and on the side of a cliff. The male lowers the forepart of the body and tips the head far back, holding its bill high. The tail is held up nearly perpendicular to the back. The wings are slightly extended and vibrated rapidly. The bird utters a high continuous chirping sound. Grass is often held in the bill during this time. When the female is receptive she assumes a similar position. The posterior portion of the body is elevated, resulting in a sharp angle between the back of the bird and the top of the head. She chirps like the male and may or may not flutter the wings. When she is in this position

the male mounts her, and coition takes place by brief cloacal contact. When not actually displaying the male spends much of his time, while in the vicinity of the female, with the body feathers fluffed out. This makes him appear twice his normal size and, with his head lowered and bill opened, serves as a threat posture directed toward other birds that approach too closely.

*Territory.*—The "territory" of the Black Rosy Finch fits none of the categories into which birds territories have been classified. (Nice, 1943: 163). In this form, as in the Sierra Nevada Gray-crowned Rosy Finch, *L.t. dawsoni*, described by Twining (1938: 246), the "territory" centers around the female bird. It varies in location and size with the movements of the female and with the activities of unmated males in the vicinity.

On June 22, 1953, in the Uinta Mountains a female Black Rosy Finch was investigating various parts of a thirty foot vertical crack on a high cliff and a male was busy trying to drive off other males. The defending male had a chase or a fight on the average of once every two minutes. These were vigorous chases, sometimes involving more than two birds. When not so occupied, the male remained close to the female, but this was seldom.

Similar observations were made almost daily until as late as July 4. During this period, a nest site was chosen and the nest built and probably completed. At some times not a single bird could be seen in the area. On one occasion when there was no activity a male appeared, flew to three different places in the large crack, which had been the center of the female's attention, and then flew away from the area after finding no other birds there. Later, when the female appeared, there were three males continually fighting. The female, being less active and sometimes hard to locate, could usually be found by noting the vicinity where most of the fighting took place. As the female moved about, so did the fighting males. When the female left the area and disappeared over the top of the cliff or around the side of the mountain, the males immediately followed. Such fighting has also been observed among feeding birds. During June and most of July a feeding female is always accompanied by a male. If another male approaches, a fight ensues. The most vigorous reaction is brought on by the combination of female and nest site. A lesser response occurs with the female away from the nest site. In the former case a strange male will not be tolerated within perhaps thirty or forty yards of the female. In the latter case a strange male may not be driven off until it is closer to the female than her mate.

The fighting centers around the female, whether this bird is in

the vicinity of the nest or on the feeding grounds. Even a nest containing eggs is left unguarded by the male if the female leaves it. From such observations I conclude that it is the female rather than an area that is defended.

This is a special type of territory made necessary perhaps by the unbalanced sex ratio in the species and by the circumstances under which it lives. The nest site may be widely separated from the feeding area. A single bird cannot defend both. While suitable nest sites and foraging areas appear to be abundant, females are comparatively scarce. It is biologically sound then that the weakest or most critical point needed for completion of the breeding cycle be defended. In this case it is the female.

*Nest site.*—Selection of the nest site is by the female. Of the eight active nests observed during the course of this study seven were in holes or cracks on vertical cliffs (Plate 5), protected from above and from all sides except the entrance. The edge of the nest was no more than five inches back from the entrance in the seven nests. In the Uinta Mountains one nest was placed in the rocks of an extensive talus slope. Except for its location on the ground, the nest was as well protected as any of the others. It was placed under a large flat rock about five feet from the only possible entrance.

In general, it may be stated that the height at which a nest of the Black Rosy Finch is placed varies from ten feet upward. The only upward limitation seems to be the height of the available cliffs. The nest is invariably well protected and concealed because it is placed in a cavity. Although the birds can utilize talus for nest sites, the cliffs are preferred, probably because of the additional protection.

*Nest building.*—The earliest date on which I observed nest construction was June 11, 1953, in the Uinta Mountains. Since I could not begin regular observations in the breeding range before this date I cannot say whether other birds had already completed nest building. The latest nest construction I observed was on July 14, 1951, at Two Ocean Mountain in the southern Absarokas in Wyoming, (except for the building of a replacement nest after destruction of the first). My observations indicate the work is done entirely by the female. The male may attempt to gather material, but after carrying it from one place to another it is eventually dropped.

*The nest.*—Nest construction, once begun, is completed rapidly. In three nests observed under construction, trips to the site with material were made from once every ten seconds to once every two minutes. I noted this pace uninterrupted, hour after hour, at a nest in the Uinta Mountains on June 28, 1953. On the preceding

day I observed the female picking up grass, but carrying it slowly to the nest, making three or four stops on the way. On the 28th nest building proceeded rapidly and was probably very nearly completed. By the third day the bird was seen leisurely feeding in the vicinity of the nest, perhaps adding some material and spending considerable time on the final arrangement of it in the structure. This same pattern was evident at two earlier nests near the same location.

A typical nest found on July 27, 1951, at Two Ocean Mountain was cupped with high rims and completely supported from below, except where the sides rested against three sides of the nest cavity. The base was of mosses while the upper portion was of grass and hair, with some moss and feathers mixed in. The lining was of finer material, hair being the favorite item. Porcupine quills, thoroughly crushed and fragmented, were used along with hair in the main body of the nest. Mosses may have been present in the cavity, and the nest constructed on top of them. Another nest examined in the Teton Mountains in 1952 and two in the Uinta Mountains in 1953 were similar.

*Eggs.*—A nest in the Uinta Mountains was being rapidly constructed by the female on June 16, 1953. On June 18 neither the male nor the female was seen near the nest. On June 20 a male was seen a few hundred yards from the nest. On June 22 this nest contained two eggs and on June 26, five eggs.

The eggs of the Black Rosy Finch are pure white. As described by Miller (1925: 6), they are ovate pyriform in shape. They appear rather long and unusually pointed at one end. I found five nests with eggs or young. These were: the above mentioned set of five eggs; a nest with four well-developed young and one egg that had failed to hatch, found in the Uinta Mountains July 20, 1953; a set of four eggs in the Teton Mountains July 16, 1952; a complete set of three eggs, believed to be a replacement, found in the Teton Mountains July 21, 1952; and a nest with four young in the Absaroka Range July 29, 1951. The three sets collected by Miller (*loc. cit.*) contained five, four and four eggs. From these data it seems that the average number of eggs per set is four or five, with perhaps the smaller number occurring more frequently.

*Replacement nest.*—Early on the morning of July 16, 1952, in the Teton Mountains I saw a nest and four eggs of the Black Rosy Finch destroyed by a Clark's Nutcracker, *Nucifraga columbiana*, (see French, 1955: 61). A short time later both birds appeared to be examining the face of the cliff. The male once visited the former nest site and, just before dark, began his accustomed loud

territorial chirping from the top of the cliff. Five days after the destruction of the nest another was found in a new location on the same cliff about a hundred yards away. It contained three eggs, which proved to be the complete set. The entire face of this cliff had been defended, when the female was present, by the male to whom the destroyed nest had belonged, so I believe that this nest was constructed by the same pair. If the original female constructed this nest and laid the three eggs, she wasted no time after the destruction of her first nest. If one egg was laid per day, the new nest must have been completed the day after the destruction of the old nest. It is possible, however, that the nest may have been finished after laying of the first egg. The small size of the set seems to be further evidence that this was a case of replacement.

*Incubation.*—Incubation is entirely by the female and begins immediately after egg laying is completed. In the one nest studied intensively during this period, in the Uinta Mountains in late June and early July of 1953, the female incubated through the night and left the nest for the first feeding period of the day a little before 5:00 A.M., approximately one half hour after daybreak. The last foraging trip from the nest was made before 8:00 P.M., about one-half hour before total darkness. In mid-summer, the birds have about fifteen hours of activity daily.

The duration of incubation was determined in one nest as approximately twelve days and in another as approximately fourteen days. At the nest in the Uinta Mountains in 1953, there were two eggs on June 22 and five eggs on June 26. The female was incubating on the latter date. Three of the eggs hatched between noon of July 6 and 4:00 P.M. of July 7. One egg remained at 10:00 A.M. July 8, and twenty-four hours later the nest contained five young. On July 21, 1952, in the Teton Mountains a nest containing three eggs was discovered. This was the replacement nest discussed. These eggs hatched between the morning of July 31 and the morning of August 3.

*Activity of male during incubation.*—The male pays little or no attention to the female while she is on the nest. In only one instance did I see the male visit the nest while the female was incubating. At two other nests the male seemed to vacate the area completely during the period of incubation. At no time did I see him about the cliff, except usually in the evening just after sundown when he came to roost. Then the male chirped loudly and continuously from some high point on the cliff and drove away any other birds that approached. On July 9 in the dim light at 8:45 P.M. he even chased a bat that came too close!

Female birds observed on the feeding grounds during the period of incubation were accompanied by males, which usually drove away other males. It seems probable that the male either awaits the female on the feeding grounds or intercepts her after leaving the nest. The male then defends his mate while she feeds and remains behind when she returns to the nest. On several occasions I saw small groups of male Black Rosy Finches foraging about the face of the cliff, unchallenged, in the vicinity of the nest while the female was incubating. Apparently the male of the pair was not nearby. In the evening when the male came to roost such birds were driven away.

*Nestlings and their care.*—The young Black Rosy Finch at hatching is completely helpless and has only a sparse covering of long whitish natal down on the dorsal surface. Its reactions seem restricted to those concerned with nutrition, notably gaping by holding the head up with mouth open, and to defecation. At one nest in the Uinta Mountains, in July of 1953, the progress of the young was followed. The nest life lasted eighteen to twenty days. The last egg hatched on July 8 or 9 and the young left on July 27 or 28.

A young bird examined on the first day after hatching had a large head with eyes not yet open although the dark eyeballs were visible through the skin. The mouth was large due to the expanded rictal region. When open it showed a red lining contrasting with the yellow edge of the bill. By the fourth day the eyes of the young bird were opening and it showed better development of responses. It held its head up slightly, was more alert and struggled to remain upright. All the feather tracts appeared dark due to enlarged papillae. The primaries and rectrices had broken through the skin. Chirping was noted at this time. On the fifth day the eyes were well opened. All feathers had erupted. Coordination was improving rapidly on the fifth and sixth days. On the seventh day the tips of the contour feathers were beginning to break from their sheaths. Fat had begun to accumulate noticeably under all of the feather tracts and especially on the flanks and abdomen. A squeal of fear was given by the young bird for the first time while it was being removed from the nest. On the ninth and tenth days the developing sheaths were breaking away from the developing teleoptiles, allowing the barbs to spread and cover the apteria. By the eleventh day they began showing fear when handled. Wing-flapping, scratching, stretching and preening were observed in captive birds on the eleventh day. At this time one of the young attempted the adult manner of sleeping, with the head turned back over one shoulder and the bill under the scapulars.

On subsequent days the nest was checked only for the presence of the young and for such observations that could be made without disturbing them. By the twelfth day even the feathers of the crown were unsheathed. The light colored tufts of feathers that were to cover the nostrils were evident but sheathed. In captive young by the twelfth day the nestlings had established definite positions in the artificial nest provided for them. They always returned to the same place after being fed. Fecal sacs were defecated over the side of the nest.

The female performs all the brooding after the young have hatched. She also feeds them for the first few days. At first there is little change in the duration of periods spent by the female on the nest, but there is a continued increase in the feeding periods away from the nest. In three nests observed with small young, in the Absaroka Range in 1951, the Tetons in 1952, and the Uinta Mountains in 1953, there was a decrease in the length of periods of brooding by the female as the young birds grew. This allowed more frequent trips to the feeding grounds. After the sixth day no brooding was observed. The female remained at the nest only long enough to feed the young. Brooding at night may continue until about the sixth day.

Not until the sixth day did the male take part in feeding the young. His approach to the nest was at first slow and cautious, but by the seventh or eighth day the male fed the young as frequently as did the female. Both adults continued to care for the young until they were independent. The parent bird delivered the food by throwing its head forward in short quick thrusts. The young bird met the bill of the parent by throwing its head forward at the same time, receiving the bill of the parent in its own open mouth. Apparently, with each thrust some food was delivered. Nest sanitation was performed by both adults. The fecal sacs were dropped some distance from the nest, usually no less than several hundred feet.

*Development of young after leaving the nest.*—After the young leave the nest and before they can fly well they are especially susceptible to predation. The gray and buffy juvenal plumage matches very closely the rocks among which the young are situated so that concealment is accomplished merely by immobility. They are just as dependent upon the adults for food as before leaving the nest. Exploratory pecking increases dexterity of the bill and eventually leads to feeding themselves. (My captive young began to eat seed ten days after they left the nest.) Judging from the state of development of young birds collected that were being fed by adults, feeding by the parents probably continues as long as two weeks after the young are out of the nest.

The tendency of the young bird to follow the parent begging for food enables the parent to guide the young to a safe or suitable location. If the parent moves away slowly the young bird follows. If it suddenly flies away the young bird is left behind.

*Aggregations of young.*—Shortly after the young are out of the nest and are able to fly well, there seems to be a tendency for them to become concentrated in groups composed of few to many families. On August 4, 1952, in the Teton Mountains a group of adults and

young of at least three families, numbering in excess of fifteen individuals, was seen feeding. Soon the entire group moved to another location. On August 4, 1953, in the Wind River Range an extremely large group of young birds, perhaps fifty in number, was concentrated in a rocky area of perhaps a hundred yards in extent. Many families were included here and the adults were continually coming and going with food. A week earlier similar family flocks were observed on rocky slopes in the Uinta Mountains. In the latter part of August, large flocks of fifty or more birds, all or nearly all in juvenal plumage, were seen in the Wind River and Bitterroot Mountains.

A possible cause of these aggregations of families and of young birds is that the adults lead their offspring to the localities that afford them the most protection. In such places the birds would become concentrated. This, however, seems not to be the case, for the groups may occur in a variety of exposed situations, such as a rocky slope or an open grassy area. Moreover, such aggregations were seen to move from one location to another *en masse*. These aggregations seem to result from the gregarious tendencies which are so strongly developed throughout the genus *Leucosticte* during most of the year. Only at the approach of breeding do other drives result in temporarily breaking up of the groups.

With the groups thus formed parental care wanes. The young birds benefit from the added protection of the group, in warning of enemies and seeking out sources of food. By the time of the molt, in late August, the adults seem to be absent from the flocks. It seems possible that they may not actually leave the flocks but rather are less active and therefore make less effort to remain with them. Because the postjuvenal molt does not include the large flight feathers, as does the adult postnuptial molt, the young birds may not be so inhibited. Adults appear to rejoin the groups after this molting period, at which time all the birds are in fresh plumage. Separate groups may then coalesce into the large active flocks that may be seen in the high mountains until the fall migration.

#### VOICE AND SONG

There are only three primary notes used by the Black Rosy Finch. These, plus variations and combinations, serve all purposes. The three call notes are: a descending, rather harsh, *chew* or *tsew*, somewhat similar to the chirping of a House Sparrow (*Passer domesticus*); a low, throaty, sharp *pert*; a high piercing *peent*.

The descending *chew* is the most variable and has the greatest

number of uses. It is the one which most nearly resembles the begging note of the young. The other notes are apparently specializations which developed as the need arose. They can be traced, through variation, to the *chew* note. The roosting or territorial call consists of a series of *chew* notes uttered rapidly and continuously. The series ascends and descends the scale apparently at random. This call was heard nightly on the breeding grounds when the birds went to the cliffs to roost and seems to function in spacing the birds.

The high *peent* serves primarily as an alarm note. It is generally given when a bird is startled. If the bird or birds are on the ground it results in either flying or crouching. It is doubtful that flocks of rosy finches post sentinels as suggested by Twining (1940: 69). Some individuals, however, are more alert than others and probably do more than their share of watching.

Large flocks, and occasionally flying individuals, utter a call in flight which resembles *pert-pert-chew*, the first two notes low and brief, the last starting high and descending. This may be designated as the flock call and probably serves to hold the group together. It is heard most frequently in winter flocks, but is also given on the breeding grounds.

Although song has been attributed to the Rosy Finches of the Aleutians (*L. t. griseonucha*) and Washington (*L. t. littoralis*) (Hanna, 1922: 88; the Leffingwells, 1931: 144), it has never been satisfactorily described. The Leffingwells (*loc. cit.*) state that the birds were "trying" to sing. This may correspond to Dawson's (1923: 156) description of the song of the Sierra Nevada Rosy Finch (*L. t. dawsoni*) as a "high-pitched ecstatic chirping" (*chew* series). According to my observations on the Black Rosy Finch, that seems the best indication of the true sound given by these birds. Applying the definition of song favored by Nice (1943: 144), "song is properly a sustained, more or less uninterrupted repetition of one or more notes conforming recognizably to a constant specific type," the vocalizations of the Black Rosy Finch cannot be considered song.

The hand-raised young had two notes when they were first taken from the nest. One of these was a soft rasping chirp, which seemed to me a hunger note. When food appeared it gave way to the begging note, a loud piercing cry rapidly repeated. The young birds first gave the adult note on the twenty-sixth day. This was a low descending *chew*. It was first uttered when the bird was peering at something outside the cage. It was given again when two people suddenly came near the cage.

## FOOD

The contents of the crops and gular sacs of seventy summer (June-August) adult specimens collected in 1951, 1952 and 1953 from mountains in western Wyoming, Montana and northern Utah were collected and preserved for later determination. The food consisted of 97% seed and 3% animal matter.

A reference collection of known seeds of the plants occurring in the areas frequented by the rosy finches was made to aid in the identifications. These data are presented in Table 1. Seeds are

TABLE 1  
FOOD OF THE BLACK ROSY FINCH

Food	Total Number	Number of Specimens Containing	% of Total seeds	% of Total food	% of specimens containing
<i>Seeds</i>					
Siviersia	1212	20	14.6%	14.2%	48.8%
Arabis	1495	11	18.0	17.5	26.8
Smelowskia	2245	17	27.1	26.3	41.5
Silene	1911	22	23.1	22.4	53.7
Lewisia	527	8	6.4	6.2	19.5
Claytonia	103	3	1.2	1.2	7.3
Carex	22	3	0.3	0.3	7.3
Sibbaldia	213	11	2.6	2.5	26.8
Myosotis	22	4	0.3	0.3	9.8
Erigeron & Aster	351	2	4.2	4.1	4.9
Oxyria	3	2	<0.1	<0.1	4.9
grass	181	2	2.2	2.1	4.9
<i>Animals</i>					
			% of total animals		
Lepidoptera	23	15	9.1	0.3	36.6
Coleoptera	17	6	6.8	0.2	14.6
Diptera	13	10	5.2	0.2	24.4
Hymenoptera	22	16	8.7	0.3	39.0
Homoptera	61	4	24.2	0.7	9.8
Ephemeroptera	12	1	4.8	0.1	2.4
pupae	13	2	5.2	0.2	4.9
unidentified	21	6	8.3	0.2	14.6
Araneida	11	3	4.4	0.1	7.3
Acarina	46	11	18.2	0.5	26.8
Nematoda	13	2	5.2	0.2	4.9
Total % unidentified	33.6%		% total food		
Total no. specimens represented	70		seed		97.2%
			animal		2.8%

listed by genera, except for grasses, and animal matter is listed by order for the insects and by classes for others. Quantity is indicated by the actual number of items in the particular sample and by percent of total numbers. The percent by volume of unidentified material is estimated. Some confusion in identification may have occurred as between seeds of *Arabis* and *Smelowskia* or as between seeds of *Sibbaldia* and *Siversia*. Seeds of *Smelowskia* and *Silene* were most numerous; those of *Silene* and *Siversia* were utilized by the greatest number of individuals. Animals which were most numerous included Homoptera and Acarina, while those used by the greatest number of birds were Homoptera and Lepidoptera.

There is a sharp decline in the amount of animal matter in the diet of the rosy finches after the middle of August. This is presumably due to the change of diet of the young as they become independent.

The growing season in the breeding habitat is short. Some of the food plants used by the Black Rosy Finch, such as *Siversia* and *Erigeron*, do not appear until after the month of August. Others, such as *Smelowskia* and *Silene*, put in their appearance soon after the snow has melted. In the Uinta Mountains in the summer of 1953, the ground was completely covered by snow until the middle of June. Only after this date did bare patches become visible in the more exposed areas. By this time the nesting activities of the rosy finches were well under way.

As the birds are present on the breeding grounds from early April, they must rely upon the seeds produced during the previous season. Seeds are probably abundant wherever there is bare ground that has been swept clear of snow by the wind. Open ground is not scarce. The high ridges and peaks above timberline are constantly lashed by strong winds, especially during the winter and early spring. Judging from the observed activity of Black Rosy Finches, they have little difficulty finding food in such situations.

In the summer of 1951 at Two Ocean Mountain, situated at the southern edge of the Absaroka Range, no insects were noticed until July 13. Within three days after their first appearance they were extremely abundant, particularly mosquitoes. In rosy finch habitat in the Teton Mountains on June 30, 1952, a hawkmoth and a stonefly were noticed on the snow, the former lifeless and the latter numbed by the cold. There were also some small dipterans. On April 26, 1953, insects were observed in the Wasatch Mountains on a high peak frequented by Black Rosy Finches. On June 10 in the Uinta Mountains insects were present.

Hence, in some localities, there is no apparent shortage of insect

food. Early in the season insects are probably carried up from lower elevations by the wind, being left on the snow as a temporary supply. In the Absaroka Range insects suddenly became abundant. Near the area studied are only high mountain valleys where there would be no source of insects. The change in abundance of insects there appeared to be correlated with an equally abrupt climatic change, after which the high mountains suddenly became habitable to various insects and they rapidly increased in numbers. This phenomenon may apply only to the locality where it was observed.

*Food of nestlings.*—After hatching, young Black Rosy Finches are given a diet consisting largely of insects. During the early nestling stage of one brood in the Absaroka Range in 1951, the adult female was observed chasing insects about the face of the cliff on which the nest was situated. This activity was interrupted only by trips to the nest to feed the young. During the time of observation the brood was receiving only insect food. By the time the nestlings were nine days old, they received some seeds along with the insect diet. After this time seeds are more and more abundant in the food. By the time the young birds leave the nest they are being fed mostly seeds, with only a few insects.

*Effect of food on breeding activities.*—If the newly hatched Black Rosy Finch requires a diet of insects, a brood of four or five young birds would necessitate an abundant source of this food. Since insect activity is limited by cold at high elevations, this factor in turn must limit the advent of the breeding season for the birds. The three days of July 14, 15 and 16 in 1951 which seemed to bring milder temperatures to Two Ocean Mountain in the Absaroka Range and a sudden increase in insects also brought a corresponding change in the activities of the Black Rosy Finches. During this period of observation prior to the change the birds were frequently observed feeding together in small flocks on the tundra. At the same time the insects became noticeable the birds showed increased signs of breeding activity. Displays of male birds were more frequent, with or without a female being present, and antagonism between male birds increased, as evidenced by more frequent and more intense fighting. In one case on July 15 a female was observed investigating cracks and holes in a large cliff, showing interest in possible nest sites. She was accompanied by a male. After a time it became apparent that the complacent flocks of feeding birds were replaced by singles or pairs. In this particular example it seemed that the increasing insect supply was correlated with the beginning of breeding. Because the growing season is extremely short at high altitudes, even a slight delay in nesting might impose a serious handicap on the young birds.

*Foraging places.*—Seeds are usually gathered on the tundra or in open areas. The Black Rosy Finches show definite preference for foraging on and about snow banks. The birds frequently drink water from the melting snow and the proximity of this water may be one reason for foraging there. The seeds and the ground itself are moist and may simplify collection and manipulation of food. Germinating material forms a considerable amount of the food and the moist areas provide the best supply. A receding snow bank is continually uncovering a fresh supply of food, and numbed insects can be gleaned from its surface.

The birds also have been seen, on rare occasions, taking seeds directly from the heads of flowers. Insects may be flushed from the ground and caught on the wing. Whole flocks of the birds may take advantage of an accumulation of moths on a warm rocky slope above timberline. I have also observed birds on the margins of ponds feeding on mayflies, usually collecting them from the rocks.

#### FLOCKING BEHAVIOR

The flocks of rosy finches are not closed flocks where strange birds are not admitted. Rather they are somewhat flexible, a few individuals departing as a group from the main flock or small groups coalescing to form a single large flock. This seems to vary with the familiarity of the surroundings. In the afternoon when the birds are in the vicinity of the roost the flocks may be quite loose, individuals coming and going at random. Early in the day, however, when the birds are away from the roost foraging in presumably less familiar regions, the birds remain in a close group and when one bird flies the entire group takes off.

In rosy finches the "following reaction" (Nice, 1943: 86) is highly developed, as it is in many social species. In flying flocks there seems to be no particular leader. The group moves as a whole and a bird that was apparently leading the flock will find itself on the sidelines when the flock changes its direction of movement. As in the Jackdaws (*Corvus monedula*) described by Lorenz (1937), the individual which acts as though it knows where it is going is temporarily the leader. The following reaction seems to be most highly developed in the response of the flock to a bird that flies. When one bird among the group suddenly flies the flock literally explodes in an effort to follow. The reaction is an automatic one. In the words of Lorenz (*op. cit.*: 252), "The only example of such automatic releasers known to me, is represented by the devices eliciting flying-in-pursuit reactions in a great many social birds. All of them are color patterns invisible in

the sitting bird, but are suddenly and strikingly unfolded at the moment of taking flight." In the leucostictes the releaser is apparently the light gray color of the under surface of the wing. The structure of the primary and secondary feathers gives this surface a dull luster when the wing is spread. The flashing movements of the beating wings cause this surface rapidly to appear and disappear, producing a strikingly visible effect. The luster of the under surface of the wing is so apparent that this is frequently the only means of following a bird that is flying high in the air. In the pause between a series of rapid wing beats the flying bird is invisible to the human eye, but the beating wings can be plainly seen flashing, appearing white against the blue sky. Flashing wings seemed to be one thing that the captive birds could not resist following. A bird might appear completely absorbed in some small object but when the other bird flew close overhead the first bird immediately forgot what had formerly interested it and followed. This was especially true if the second bird had just taken off and the wings above were noisily straining in the effort to gain elevation.

There are certain other signals that serve to bring and to hold the group together. The auditory signals have already been discussed. The means by which a flying bird recognizes an almost imperceptible flock feeding on the ground is uncertain. Numerous times I have observed a lone bird, flying quite high, turn abruptly when almost directly over the flock and plummet straight down to alight among them. The turning point seems to come when the bird is directly over the feeding birds. Whether this is a peculiar habit of flight or some signal is received at that particular point is uncertain. It seems possible that the striking gray crown patch may serve some function here.

#### WINTER ROOSTS

The rosy finches have communal roosts in winter. The same roost is utilized by the birds year after year. I would estimate the numbers of birds utilizing each of the four roosting locations I have observed between 200 and 600. The known winter roosts are few but in at least two locations the same shelter has been used by the rosy finches for several years. The primary requirement seems to be overhead shelter. Since the birds are gregarious there must be an abundance of perching space. In addition, the birds usually choose perches against walls or in corners where there is also protection from the sides.

Two roosts located near Salt Lake City are both man-made structures. A recreation establishment on the shore of Great Salt Lake ("Saltair") provided an abundance of roosting sites such as the sup-

porting structure of an elevated pier, change rooms used in summer by swimmers, elevated water tanks, and open-sided railroad cars (Plate 6). A few miles south is an explosives manufacturing plant where rosy finches roosted. Numerous buildings rather widely spaced provided suitable roosts on beams, door sills, under eaves, etc. *L.t. tephrocotis*, *L.t. littoralis*, and *L.t. atrata* were reported wintering at this roost (Behle, 1944) and were still utilizing it ten years later.

During the winter of 1953-54, the most intensive banding was done at the two roosts. Forty-nine birds were recaptured at the same roost where they were banded, 30 *atrata*, 16 *littoralis* and 3 *tephrocotis*. Only twice were birds, both male *atrata*, recaptured at a roost other than that at which they were banded, one during the same winter, the other a year and a half later. One bird, also a male *atrata*, was found at the same roost thirteen months after it was banded there. The oldest bird observed was a male *atrata* banded in March of 1953 and recovered at the same roost in January, 1957.

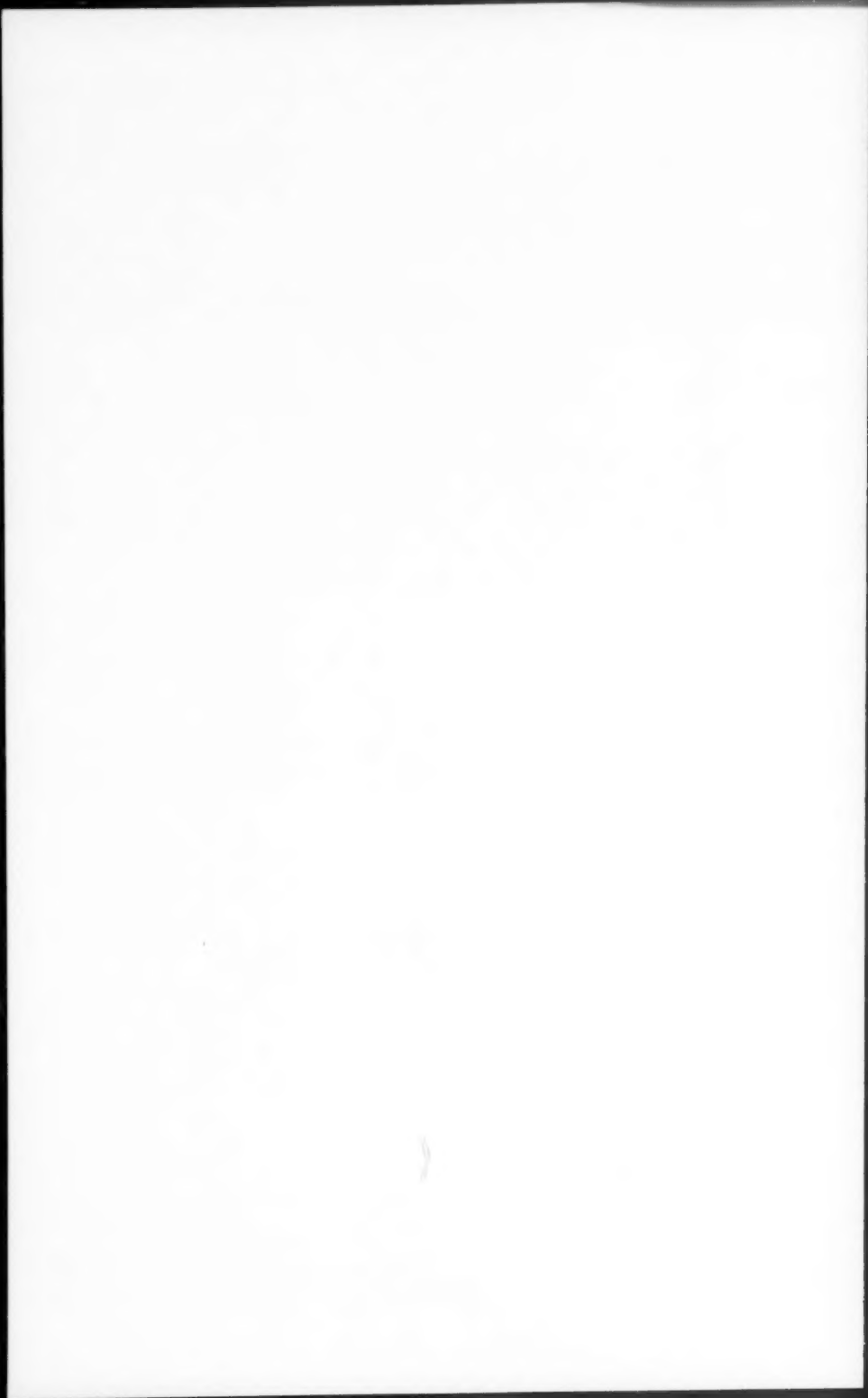
Rosy finches were reported roosting in mine shafts in eastern California by Miller and Twining (1943: 78). There have been reports of the birds roosting in abandoned Cliff Swallow nests (Leffingwell and Leffingwell, 1931). This may seem an unusual situation but it apparently meets all requirements. In Colorado I observed all four varieties of rosy finches roosting in a cave formed by a crack, two feet wide at the top and nearly ten feet wide at the bottom, which extended through a large rock nearly a hundred feet in height and equally broad. The birds entered through the widest opening in the cave and were probably roosting on projections or cavities in the walls. *L.t. tephrocotis* and *L.t. littoralis* were also found utilizing the entrance of a large cave in southeastern Idaho (Plate 6).

In the winter of 1952-53 the rosy finches roosting in the railroad cars at Saltair were regularly and rather frequently disturbed at night for banding purposes. It was not long before the birds learned to avoid this disturbance by roosting elsewhere, under nearby water tanks and buildings. The same perches are repeatedly used by the birds throughout the winter and in some cases through successive seasons. Piles of excreta build up at certain spots due to continuous use while other perches, which appear equally suitable, go unused.

That the birds have taken advantage of man-made structures for roosting indicates that they are, in this respect, adaptable. Reports of their using abandoned buildings are not rare. Large flocks frequently visit human habitations in winter for food as well as shelter. There is one report (Cahn, 1947) of the Aleutian Rosy Finch, *L.t. griseonucha*, nesting on the window ledge of a warehouse. It is



Winter roosts of Rosy Finches. (Above) Pier at Great Salt Lake under which birds found shelter suitable for roosting. (Below) Entrance to cave in southeastern Idaho showing natural roost of the birds. Three to five hundred *Leucosticte t. tephrocotis* and *L.t. littoralis* have been seen coming to this roost an hour and a half before sundown. They utilize any spot in or around the cave entrance where there is an overhang to provide shelter, some birds roosting less than five feet above the ground.



entirely possible that rosy finches would become adapted to nesting in and about man's dwellings if such structures were erected in the breeding habitat of the birds.

#### THE FACTOR APPARENTLY LIMITING POPULATION

The density of the population in summer and winter must be considered separately. In the breeding season the individuals are so widely spaced that there seemingly could be many more in the available habitat. In localities where they have been observed there is abundant space for nest sites; there seems to be a great quantity of unutilized food and little or no competition for it.

In winter the birds occur in groups that are localized. These groups do not normally travel widely and there seems to be room and food available for many more groups than there are. Only for brief periods after heavy snowfall is food difficult to find. The areas inhabited by the birds in winter are for the most part free of excessive snow.

Although predators, such as the weasel and the Clark's Nutcracker, take a toll, this seems to have little effect on the population density. One brood of nestlings in northwestern Wyoming was infested with larval protocalliphorid flies. These were submitted to the National Museum for identification where they were considered a new species, but remain unnamed. There is no evidence that populations vary with the varying density of predators.

The only element in the life of the Black Rosy Finch that seems to be in shortage is the female of the species. All available evidence indicates that there is an unbalanced sex ratio. In winter flocks the birds were counted and it was found that there were always more males than females. The ratio varied from one female and six males to one female and fourteen males. Of the 93 Black Rosy Finches banded in the winter of 1953-54 fourteen were females and seventy-nine were males. This is a ratio of one female to 5.6 males. On the breeding grounds the same holds true. Male birds are not difficult to find but females are scarce. An estimate based on observations is one female to about six or eight males. The scarcity of female birds is also indicated by the situation described in the discussion of territory, where several males persist in their interest in a single female. This unbalanced ratio seems to exist in young birds also. Of seven birds taken in juvenal plumage only two were females. Of nine freshly molted birds collected, only two of the seven young birds were females, and a special effort was made to secure these. Of 118 specimens collected, I succeeded in taking only 38 females as compared

to 80 males. Again, extra effort was applied to securing females. A similar discrepancy in sex ratio has also been observed or indicated in *L.t. dawsoni* (Dawson, 1923, and Twining, 1938), and in *L.t. griseonucha* (Hanna, 1922).

#### IMMATURE PLUMAGES, MOLTS, PINK COLOR, AND BILL COLOR

*Natal down.*—The down feathers are approximately three-eighths of an inch in length, covering much of the dorsal surface of the bird, but arising from only a few limited areas: the capital tract on the top of the head, the dorsal region of the spinal tract in the middle of the back, the dorsal surface of the alar tract on the wing, the distal portion of the crural tract and the middle portion of the femoral tract just posterior to the thigh. On the top of the head the down is in three rows, one above each eye socket, these converging in front, and the third across the occipital region.

*Juvenal plumage.*—Above, the young bird is similar to the adult female. The general coloration is Lilac Gray (Ridgway, 1912), darker dorsally. The head of the juvenile is lighter than that of the female, the former having more bluish gray, and there is no indication of the light gray saddle as in the adults. The adult occiput is darker, nearer Pallid Mouse Gray. The juvenal marginal coverts are edged with pink as in the adult, but these do not develop fully enough to show when the wing is folded, until just prior to the postjuvenal molt. The contour feathers have brownish edges but are darker centrally, the gray basal portions being more extensive and making the back appear somewhat lighter. The juvenal nasal tufts are whitish as in the adults. The remiges and rectrices are darker than those of the female, being in this respect more nearly like the male. The juvenal secondaries show broad buffy margins and the central rectrices have a narrow margin of a similar color. The remaining rectrices and especially the primaries show distinct but narrow whitish margins. The outer margins of the primaries and their coverts have a narrow band of pink. On the first two or three secondaries this color gradually changes to buffy brown. Ventrally the bird is a uniform bluish gray with the cinnamon-buff tips to the barbs superimposing on this a faint buffy color.

*Molt.*—Because of the incomplete postjuvenal molt, birds in the first winter plumage can be distinguished from adults. Juvenal wing and tail feathers are retained. These have less extensive white edgings, especially near the tips, and less pink on the outer margins of the feathers. This color is most pronounced in adults along the bend of the folded wing where the overlapping primaries, secondaries and their coverts make an almost solid area of pink. In late winter or early spring, after the feathers have undergone considerable wear, the intensity (not the shade) of pink in this region may be the only way to distinguish between first winter and fully adult birds. The breeding dress results from such wear.

The postnuptial molt was followed almost feather by feather in a captive bird and observed in eighteen molting specimens collected. The molt of the flight feathers in the captive bird was slightly asymmetric, the right wing being slightly advanced over the left in development of a particular feather. One bird collected in the field was similarly asymmetric. The earliest dates on which wild birds were found molting were August 15, 1952, in the Absaroka Range of Wyoming and August 16, 1953, in the Bitterroot Mountains of Montana.

The molt is initiated almost simultaneously on the head, the sides of the breast and the wing primaries. Replacement proceeds from inner primaries to outer,

a single feather being about half grown before the adjacent one falls. The molt of the secondaries apparently begins with the proximal feathers and is followed closely by the distal ones. Replacement then proceeds rather rapidly from both directions toward the middle. Secondary number one is lost at about the time primary six is half developed and before primary seven is lost. The molt of the secondaries is completed at about the same time as that of the primaries.

The greater secondary coverts are being replaced by the time the third and fourth primaries are developing. They develop nearly simultaneously and well in advance of the replacement of the secondaries. The marginal, median and lesser coverts begin replacement after the greater coverts are well developed. Replacement begins centrally and progresses toward both anterior and posterior margins of the wing, and is completed at the time the last primary is being replaced. The feathers of the alula and the under wing coverts are molted at about the time primary seven is shed.

The rectrices are lost in pairs, the corresponding feathers on opposite sides being shed and replaced together. This begins at the time primary five is shed. When these are half grown the next pair drops out. This continues, the outermost pair being the last to be replaced and is completed at about the same time as the molt of the primaries. The middle four rectrices were molted simultaneously in the captive bird and in at least one of the specimens collected. The tail coverts are replaced along with the rectrices.

The back of the crown is probably the first area to show the molt. This is followed by molting on each side of the breast, then on the femoral tract and the thoracic region of the dorsal tract. Feather replacement is under way in all these regions by the time the fourth primary is breaking from its sheath. From these centers the molt spreads over the body. This process continues slowly on the head until about the time when replacement of the secondaries begins. Then feather replacement on the head seems to accelerate. The sides of the head and neck are the last regions of this area to complete the molt.

*Effect of captivity on pink color.*—When the young birds raised in captivity underwent the postjuvinal molt they failed to develop the normal red pigmentation, but showed buffy instead. The failure of this color to develop in various captive finches has been noted (Arvey, 1938: 263) and has been attributed to diet. Germinating seeds were added to the diet of dry seeds given to the young birds with no apparent effect upon the color of the new feathers. A male Black Rosy Finch trapped in late November and retained in captivity began to molt in March. This bird, normally pigmented prior to the molt, failed to develop the red color and, after molting, resembled the young birds reared in captivity.

*Variation of pink color in wild birds.*—Color variation has also been observed in nature. Six males collected in the same locality in August, 1953, in the Wind River Range show variation from Strawberry Pink to Rose Doree. Two female specimens from the Uinta Mountains have a light Salmon-Orange color very similar to that shown in the captive birds. In other females from the same locality the pink is better developed (Geranium Pink) (nomenclature of Ridgway, 1912).

There may be some difference in the intensity of this color due to age. A series of young males just completing the postjuvinal molt has the pink paler than two adults completing the postnuptial molt. In addition, there is a change in this color during the winter. The pink is softer or paler in the fresh winter plumage and becomes more intense at the approach of the breeding season. This is probably due to the wearing off of a thin film of barbules on the feathers.

Other members of the Fringillidae are known to change plumage color under unusual conditions. The red color is particularly affected in captivity (see Mayr, 1942: 60) and sometimes in nature (see Michener and Michener, 1931 and 1932). Howell (1952: 244) called attention to the fact that almost all of the red pigments in birds are carotinoids and that birds have never been shown to be capable of synthesizing these pigments. Evidence seems to indicate that they are acquired in the diet (Arvey, *loc. cit.*). Observations on rosy finches seem to suggest not only sexual variation but also individual variation either in diet or in the physiological processes necessary for absorption and deposition of these materials.

*Color of bill.*—In breeding rosy finches the bill is solid black. In winter birds the bill is yellow, only the tips showing some black. The transition to the breeding condition begins in the Black Rosy Finch before the end of February. Pigmentation begins at the tip and gradually spreads to the base. By the end of March, at about the time of spring migration, nearly all of the bill has darkened except at the angles of the commissure, where some yellow may remain. The darkened portions at this time, however, are not the intense black color that is found in breeding birds. Pigment deposition continues until the solid color is attained.

Not all birds have the bills at the same stage of pigmentation. In general, *L.t. littoralis* and *L.t. tephrocotis* are about two weeks behind *atrata* in amount and intensity of bill pigmentation in the spring. Near the end of July or early August the reverse transition in color of the bill begins. At first the bill begins to turn yellowish at the base and this progresses distally. By the time the post-nuptial molt is complete, less than half of the bill remains black. When the birds arrive on the wintering grounds, the bills are in typical winter condition.

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#### SUMMARY

An account of the breeding activities of the Black Rosy Finch *Leucosticte tephrocotis atrata* is given. The territory centers around the female bird. The nest is usually situated in a small cavity on a vertical cliff. Four or five eggs are laid early in June. The female alone builds the nest and incubates the eggs. Incubation lasts twelve to fourteen days. Both parents feed the young, which leave the nest at approximately twenty days of age. Feeding by adults continues as long as two weeks after the young leave the nest. Family groups soon join together to form flocks. The call notes of the Black Rosy Finch

are described. These birds are considered songless, as the "song" is a primitive or unspecialized effort.

The seeds of three genera of alpine plants formed the major food of the rosy finches, with animal matter being taken occasionally, but especially when the young are being fed. The advent of breeding may be correlated with the insect supply.

Flocking behavior is discussed. The birds concentrate in large flocks during the winter and utilize the same buildings or caves for roosting year after year.

All available evidence indicates that males outnumber females by approximately six to one. This is believed to be the main factor limiting increase of population of the species.

The Black Rosy Finch is the only member of the genus in North America that shows strong sexual dimorphism. Molts and immature plumages are described. Considerable variation in red pigmentation was noted. The bill becomes darkly pigmented during the breeding season but is yellow at other times.

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## NOTES ON THE BREEDING CYCLE OF THE RED CROSSBILL (*LOXIA CURVIROSTRA*) IN MONTANA

BY THOMAS KEMPER

### INTRODUCTION

The Red Crossbill (*Loxia curvirostra*) has been known to breed every month of the year (Griscom, 1937), thus seeming to defy the mechanisms postulated currently to control the breeding cycle of small passerines (Burger, 1949; Wolfson, 1952). It was with this thought in mind that the author decided to study the reproductive condition of a flock of Red Crossbills that arrived at the Biological Station of the Montana State University at Yellow Bay, Montana. The birds arrived during the middle of July 1954, and appeared in increasing numbers until the middle of August when it was possible to trap twenty-three birds in one day.

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### METHODS AND MATERIALS

A total of 169 birds was examined. Of these, 163 were trapped during the period August 1st to 15th and four from July 13th to 31st; two birds were collected on June 22nd. No crossbills were noted by the author in the area prior to June 22.

With the exception of the two birds collected, all the birds were trapped in sparrow traps placed over urinated soil on which the birds were feeding. The ground was also salted with table salt. The traps were open continuously from July 13th to August 15th. Of the 169 birds observed 26 were prepared as study skins for subspecific identification and their gonads and vasa deferentia or oviducts saved for histological study. For an additional five males no skins were made, but their gonads, vasa deferentia and seminal vesicles (glomera) were preserved. The gonads of 31 birds, 24 males and 7 females, were studied histologically. The remaining 138 birds were banded with U. S. Fish and Wildlife Service bands and released. For most of the trapped birds and for the 31 birds that were autopsied the following observations were made: body weight, length of exposed culmen, depth of culmen, length of chord of wing, (preceding three measurements after Baldwin *et al.*, 1931), amount of yellow in the plumage of the males (roughly estimated), presence and development of brood patch, cloacal development (Wolfson, 1954), and fat deposition. With the exception of the two birds taken on June 22nd, the birds autopsied were collected during the period of August 6-10. The ma-

terial for histological study was fixed in AFA and then stored in 80% alcohol. Observations on the reproductive system included weight and extent of follicular development of the ovary, weight and greatest width of the seminal vesicle, extent of coiling of the vasa deferentia, and the size of the testis. The volume of the testis was calculated from the volume of an ellipsoid. The stages of spermatogenesis are those of Wolfson (1942). The gonads and accessory organs were weighed with a Roller-Smith torsion balance.

Body measurements were taken with a small ruler calibrated in millimeters. Measurements of recaptured birds showed that the original measurements were accurate to plus or minus 1 millimeter. Measurements of fresh skins taken with calipers showed similar agreement. This range is too great to permit accurate assay of subspecific status, except for the wing measurement.

According to Griscom (1937), in *bendirei*, the breeding race of the northern Rocky Mountains to central southern Montana, the male has a wing measurement of 86.5 to 94 mm; in *sitchensis*, the race breeding in the northwestern Pacific coast, the wing measurement of the male is 81 to 85.5 mm; in *benti*, the race breeding in southeastern Montana and the Rocky Mountain region of Colorado, the wing measurement of the male is 93 to 98 mm. The relationship between the latter two races is apparently poorly understood. The race normally breeding at Yellow Bay is *bendirei* (A.O.U. Check-list, 1957: 575).

TABLE I  
FREQUENCIES OF WING MEASUREMENTS

Wing measurement (millimeters)	No. of Males	No. of Females
95	0	0
94	4	0
93	2	0
92	16	0
91	15	0
90	18	2
89	26	1
88	15	3
87	9	3
86	4	2
85	8	2
84	6	3
83	1	8
82	1	1
81	2	6
80	0	5
79	0	0
78	0	1
77	0	0

The males with wing measurements from 88 mm. to 94 mm. probably represent the race *bendirei*. See the text for a discussion of this group. The males with wing measurements of 81 mm. to 86 mm. probably represent the race *sitchensis*. The wing range for the females of these races is not known.

## MEASUREMENTS, PLUMAGE AND MOLT

*Wing measurements:* Table 1 shows the frequency distribution of the wing measurements of all the birds measured (155). On the basis of the wing measurements given by Griscom (1937), 96 of the males were probably *bendirei* and 22 were probably *sithkensis*. No attempt was made to ascertain the racial status of the trapped females. The wing-measurement frequency of the male birds was plotted for each day of trapping and revealed that the daily catches of birds were a mixture of both *sithkensis* and *bendirei*. The birds probably arrived as a mixed flock. Table 2 gives the summary of the subspecific status of the skins as determined by G. M. Bond of the U. S. National Museum.

There were 8 birds, 4 males and 4 females, identified as *bendirei*, and 4 birds, 1 male and 3 females, identified as *sithkensis*. The remaining 14 birds had the measurements of *bendirei*, but Bond reported (*in litt.*) that they "... do not agree in color with a presumably breeding series of that form from Idaho, Washington and Oregon, which are decidedly more orange in coloration. Instead, the underparts of the fourteen birds from Montana are a bright clear rosy red and approach the color of the one specimen of *bentii* which we have for comparison. However, since the degree of relationship between these birds and *bentii* is obscured by our lack of comparative material, I believe it best to refer all of these birds, at least tentatively, to *bendirei*." The birds in Table 2 referred to as "*bendirei*" are these 14 birds, which for the purpose of this paper will be considered as representing the race *bendirei*.

Of the 138 birds that were banded in this study, only six were recaptured. The average interval between initial banding and recapture was 9 days, with a spread of 17, 11, 11, 8, 5, and 2 days. This low recapture rate from a flock which was presumably active reproductively is unusual and is discussed below.

*Yellow feathers on the males:* Notes were taken on the amount of yellow in 78 males by estimating the extent of the yellow area. Only two males were found that were all red, the remaining 76 showing some degree of yellowness. Two of the males were almost entirely yellow and had only a few red feathers; in addition to these two, there were 5 birds that were more than half yellow, 52 of the birds were noted as being less than 1/10 yellow. The remaining 17 were from 1/10 to 1/2 yellow. All of the birds skinned showed an adult type of skull. (See Tordoff, 1952 and Jollie, 1953 for a further discussion of this subject.)

*Molt:* Many of the birds examined were just starting the annual molt (postnuptial). The replacement of the primaries and head feathers had begun. Since many of these birds showed active gonads (Stage 5), the molt appears to be independent of gonadal regression. Bailey (1953) also found some evidence for this in the crossbill.

## REPRODUCTIVE ORGANS

**Gonads:** Table 2 gives the weights and other data for the gonads and accessory organs. Two of the females identified as *sithkensis* were about to ovulate, and the testis of the male *sithkensis* was quite active. These birds appeared to be capable of breeding at the time the specimens were taken, though far from their supposed normal nesting range. It can also be seen from the data that a female *bendirei* was ovulating, having ovulated three eggs and about to ovulate a fourth. The female secured on June 22 had ovulated four eggs, one of which was in the distal end of the oviduct and was being covered with its shell.

With the exception of one specimen, all the testes were in active spermatogenesis (Stage 5), indicating that the population as a whole was probably in active spermatogenesis. The one exception was a bird for which no skin was saved that was collected on August 7th. It was in early regression from stage 5 according to Wolfson (personal communication) and may have been part of an *earlier* breeding population.

**Vasa deferentia:** The size and states of development of the vasa deferentia are given in Table 2. It can be seen that they were quite variable and that there were very few birds that had really well-developed vasa deferentia. Although little work has been done on their development, it is likely that it roughly parallels that of the seminal vesicles. Wolfson (1954) indicates that the fully developed and coiled vasa deferentia probably do not occur until the seminal vesicle (glomus) is well developed. The lack of fully developed vasa deferentia in birds with testes in Stage 5 probably indicates that the birds have not yet reached but are approaching breeding condition.

**Seminal vesicle:** Further evidence that the birds were approaching breeding condition was seen in the state of the seminal vesicles. Although none of them weighed more than 15 mgs., all of them contained sperm. Wolfson (1954) states that the development of the testis and seminal vesicles in other species starts at about the same time, but the fully developed seminal vesicle occurs only after the gonad has been producing sperm for some time. The data given by Wolfson (1954) indicate that the fully developed seminal vesicle for a bird of comparable size is several times the size of those obtained from the crossbills.

**Cloaca of males:** Observations on the cloacal region of 82 males also indicate that the population was just coming into breeding condition. In 18 of the birds examined the cloaca was well developed,

TABLE 2  
DEVELOPMENT OF THE GONADS AND ACCESSORY ORGANS

Males—skins prepared						
Subspecies	Date Collected	Gonadal Right	Volume Left	Vas Deferens	Seminal Vesicle	
<i>bendirei</i>	June 22, 1954	—	82	3/4 coiled	—	
"	Aug. 6, 1954	43	76	1/3 coiled	—	
"	"	108	90	almost entirely coiled	—	
"	"	57	51	almost entirely coiled	—	
" <i>bendirei</i> "	Aug. 6, 1954	44	62	no coiling	—	
"	"	89	99	1/2 coiled	—	
"	"	83	75	entirely coiled	—	
"	"	33	55	slight coiling	—	
"	"	63	109	slight coiling	—	
"	"	84	80	moderate coiling entire length	—	
"	"	23	27	slight coiling	—	
"	Aug. 7, 1954	42	70	2/3 coiled	—	
"	"	64	85	almost entirely coiled	—	
"	"	59	76	almost entirely coiled	—	
"	"	68	79	slight coiling lower 3/4	—	
"	"	55	80	slight coiling lower 1/2	—	
"	Aug. 8, 1954	42	52	2/3 coiled	—	
"	"	55	55	slight coiling lower 1/2	—	
<i>sitchensis</i>	Aug. 8, 1954	53	68	1/2 coiled	—	
Males—no skins prepared						
Wing measurement	Date Collected	Gonadal Right	Volume Left	Vas Deferens	Seminal Width	Vesicle Weight
89 mm	Aug. 6, 1954	66	86	1/2 coiled	2.5 mm	15.0 mgs
89 mm	"	68	92	1/3 coiled	2.5 mm	15.0 mgs
91 mm	Aug. 7, 1954	77	97	moderate coiling almost entire length	2.5 mm	13.4 mgs
87 mm	"	49 (regression)	79	slightly coiled entire length	2.2 mm	5.0 mgs
87 mm	"	53	60	1/3 coiled	2.7 mm	9.6 mgs

The volumes of the testis are in cubic millimeters. For a discussion of the group labeled "*bendirei*," see text. When skins were prepared the seminal vesicles could not be preserved for measurement. The measurements of the seminal vesicle are for one vesicle.

TABLE 2 (CONTINUED)

Subspecies	Date Collected	Females—skins prepared		Weight of Oviduct
		Ovary	Weight Largest Follicle	
<i>bendirei</i>	June 22, 1954	ovulating	1.7 mm	egg in shell gland
"	Aug. 5, 1954	ovulating	10.2 mm	egg in oviduct
		(3 eggs ovulated)		
"	Aug. 6, 1954	29.2 mgs	1.0 mm	54.4 mgs
"	Aug. 7, 1954	36.8 mgs	2.3 mm	22.2 mgs
<i>sithkensis</i>	Aug. 6, 1954	39.6 mgs	2.4 mm	123.8 mgs
"	Aug. 8, 1954	208.2 mgs	7.0 mm	629.4 mgs
		(no follicles ovulated)		
"	Aug. 10, 1954	146.6 mgs	4.7 mm	793.8 mgs

The weights of the oviducts and ovaries are used as an index of activity, therefore no weights are given for the two birds that were laying.

but only 8 birds showed the nodules on the lateral walls of the cloaca (produced by the enlarged seminal vesicles). (See Wolfson, 1954, for the anatomy of this region.) In 15 of the 82 birds, there were no signs of any cloacal development; the remaining 49 birds showed various gradations up to the "fully" developed state. Table 3 gives the measurements of several of the cloacas. Wolfson distinguishes two types of cloacas, a bulbous type and a cylindrical form, based mostly on the position, form, and extent of development of the seminal vesicles. In the bulbous form the seminal vesicles are nodular, meet in the midline, and protrude noticeably in the posterior aspect of the cloaca. In the cylindrical form the seminal vesicles are placed more laterally, and do not meet in the midline; they protrude less, thus not producing the characteristic bulge of the bulbous type. It is difficult to place the well-developed cloacas seen in this study in either group. The seminal vesicles were in the lateral position, as in

TABLE 3  
CLOACAL MEASUREMENTS\*

<i>bendirei</i> , male.	June 22, 1954.	Ant. wall $6\frac{1}{2}$ , post. wall 6, ant.-post. 5, rt.-left 6.
This specimen noted as being well developed.		
<i>bendirei</i> , female.	June 22, 1954.	Ant. wall $2\frac{1}{2}$ , post. wall 7, ant.-post. 6, rt.-left $6\frac{1}{2}$ . This bird was ovulating.
<i>bendirei</i> complex, male.	August 6, 1954.	Ant. wall $3\frac{1}{2}$ , post. wall 4, ant.-post. $4\frac{1}{2}$ , rt.-left 5. This specimen was noted as being moderately well developed.
Seminal vesicle 15 mgs (each).		
<i>sithkensis</i> , male.	(Wing $84\frac{1}{2}$ ). Banded August 4, 1954.	Ant. wall $4\frac{1}{2}$ , post. wall 6, ant.-post. 4, rt.-left 5. This bird was noted as being well developed and having visible nodules. A drawing made in the field shows the nodules in a posterior-lateral position and protruding.

\* All measurements in millimeters. Measurements of cloaca are given first for anterior and posterior walls; these are followed by the anterior-posterior and right to left widths.

the cylindrical form, but they seemed to protrude too much for the true cylindrical form. It seems best to classify them as a modified cylindrical type.

*Cloaca and brood patch of females:* Two of the 19 females examined had swollen cloacal lips like those observed in the ovulating females that were autopsied; 10 birds had cloacas that were well developed but they were not in the ovulatory stage. Two of the females showed no development at all. Most of the fully-developed female cloaca was due to the greatly enlarged distal end of the oviduct, thus probably many of the females were going to ovulate in the next few days or were ovulating.

Observations on the development of the brood patch (apterium) of 34 females also indicated that the females were sexually active. Nine of them had bare apteric regions; 7 showed some folding of the skin in the apterium, and 5 of them were quite vascular. The presence of a bare medium apterium indicates that the female either has bred since the last molt or a brood patch is just beginning. Only the presence of the folded or vascular apterium is evidence of incubation; hence probably five of the females were incubating.

Judging from the histological and cloacal picture in the male, the condition of the female reproductive tract, and the cloacal picture in the female, it seems highly probable that some of the birds were actually breeding. During the period of the study no nests and *no juvenile crossbills were seen*. Since the birds arrived in good numbers about the last of July and the first of August, and since it requires about 43 to 48 days from the time that nest construction starts to the end of the fledgling period (Bailey, 1953), juveniles should not have been present.

#### DISCUSSION AND CONCLUSIONS

The most probable explanation for the sudden occurrence of such a heavy density of crossbills was the excellent cone crop of the common conifers in the region. Douglas Fir (*Pseudotsuga menziesii*) Grand Fir (*Abies grandis*), and Engelmann Spruce (*Picea engelmannii*) had heavy cone crops. Ponderosa Pine (*Pinus ponderosa*) had a moderate crop, and the Western Larch (*Larix occidentalis*) had a light cone crop. There was, therefore, an excellent food supply to support the large number of crossbills.

There are several aspects of these observations of crossbills that merit discussion and further study. The fact that there was such a high density of birds in active spermatogenesis and apparently breeding, yet few recaptures of banded birds is puzzling. The fact that the

birds were approaching breeding condition or actually breeding (judging from the condition of the reproductive organs and accessory structures) at a time when other birds were ending or had ended their breeding cycle appears enigmatic in terms of our present understanding of the control of the annual cycle. However, it is well established that crossbills can breed in every month of the year (Griscom, 1937).

The major problem seems to resolve itself into an understanding of the control of the breeding cycle of the crossbill. Light, or the relation between daily periods of light and darkness, has been shown experimentally to be a regulatory factor in the breeding cycles in some small passerines. In the case of the crossbills, it is difficult to conceive of light operating in the same way and as the sole regulatory factor of its breeding cycle, since the species is known to breed in every month of the year. Bailey (1953) states that in Colorado the resident race, *benti*, starts to breed in December. If day length initiates the cycle, crossbills would have to respond to the day length conditions which precede December. If day length is a factor, it is probably strongly modifiable by one or several other factors. Psychological stimuli are important for the development of the ovary and ovulation in the female. A female bird kept on photostimulative day lengths shows only slight elevation above the minimal gonadal condition, but a female in the wild with a photostimulative day length and proper behavioral (psychological) stimuli will ovulate. Thus, in the female, behavior and psychological stimuli are important factors. Burger (1953) showed also that in Starlings (*Sturnus vulgaris*) exposed to photostimulative day lengths males that were kept in cages with females showed greater gonadal development than those kept in cages without females. In the crossbill, it is possible that psychological stimuli are important for breeding in both sexes. Another factor that must be considered in the regulation of the breeding cycle of the crossbill is food supply and nutrition. When the cone supply is adequate perhaps the pituitary gland is stimulated to secrete more gonadotropins and thus maintain the bird in, or initiate, breeding condition.

#### SUMMARY

A mixed flock of Red Crossbills that arrived at Yellow Bay, Montana from the middle of July to the middle of August showed physiological and anatomical evidence of being in breeding condition while also beginning the annual molt. Since other birds in the region had finished breeding or had almost finished, the late breeding condition of the crossbills may be explained by the excellent cone crop and possibly psychological factors. It was not possible to deter-

mine whether a previous period of reproductive activity was being maintained or a new breeding cycle was being initiated. No nests or other signs of actual breeding were observed.

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OBSERVATIONS ON THE LIFE HISTORY  
OF THE DIPPER IN MONTANA

BY GERALD J. BAKUS

Aside from incidental notes, relatively little has been published on the American Dipper (*Cinclus mexicanus*). Grinnell and Storer (1924), Ehinger (1930), Bent (1948) and others have contributed valuable material in the past. More recently Hann (1950) published a thorough study of the nesting behavior of the Dipper in Colorado. An attempt was made in the present study to stress those aspects of life history for which reported observations have been lacking.

The study area was defined as Rattlesnake Creek, Missoula County, Montana, extending from its outlet (into the Clark Fork River) to the upper end of the canyon road near the stream (fig. 1). This is 13 miles by road. All the stream bank area plus nearby tributaries and beaver ponds were considered in the study, if these were occupied by Dippers. The study was carried out from January, 1956 through August, 1957.

I am indebted to many persons for help in connection with this study, especially to Dr. Robert S. Hoffmann for assistance during this study and in the preparation of this paper, to Dr. Ludvig G. Browman for information on the topography of the Rattlesnake drainage, to Harold Knapp for participation in the field work and for advice, and to my wife, Grace Bakus, who aided in preparing this report.

## DESCRIPTION OF THE STUDY AREA

The entire Rattlesnake Creek drainage is located within Missoula County, Montana. The outlet of Rattlesnake Creek is in the city of Missoula at an elevation of 3200 feet, approximately 100 miles west of the continental divide, in west central Montana (fig. 1). The city of Missoula and the first few miles of Rattlesnake Creek are located within a broad, flat valley utilized for farming. The stream passes through a riparian deciduous forest community of cottonwoods (*Populus trichocarpa*) which higher up is replaced by a coniferous forest of intermixed yellow pine (*Pinus ponderosa*), Douglas fir (*Pseudotsuga menz*), and the deciduous western larch (*Larix occidentalis*). At yet higher elevations, Engelmann spruce (*Picea engelmanni*) is present along with Douglas fir. The bank is lined with willow (*Salix* sp.), alder (*Alnus tenuifolia*), wild rose (*Rosa* sp.), hawthorn (*Crataegus douglasii*), and dogwood (*Cornus stolonifera*), which frequently form dense thickets. The width of the stream within this area varied from 10 to about 50 feet. Juvenile and adult birds were trapped with a

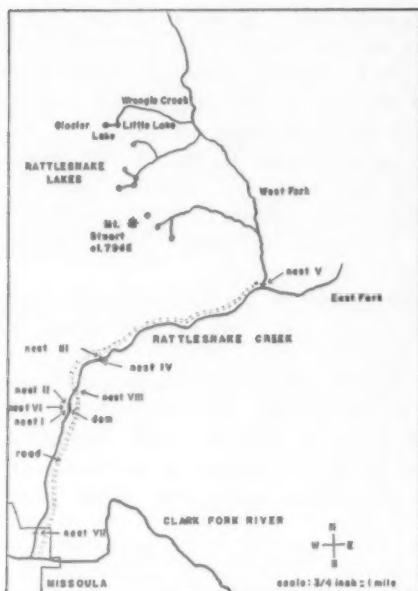


FIGURE 1. Map of Rattlesnake Creek drainage.

Japanese mist net and color-banded within the study area, and nestlings were similarly marked.

#### DISTRIBUTION

The species *Cinclus mexicanus* is found in western North America from the Aleutian Islands, north-central Alaska, and central Yukon, southward in mountainous country, east to Alberta, Montana and southwestern South Dakota, and south to southern California and through the highlands of Mexico and Central America to western Panama (A. O. U. Check-list, 1957: 405).

Many authors (Skinner, 1922; Johnston, 1943; Packard, 1945) have reported the altitudinal distribution of the Dipper as extending from the Upper Sonoran or Transition Life zones up to or near timberline. However, they have been found even in the lower Sonoran zone in Arizona by Hargrave (1939: 122). In western Montana, Dippers are found on some parts of the valley rivers, such as the upper Bitterroot River, throughout the year (Harold Knapp, unpublished field notes). During the summer they are most commonly found in the Upper Transition and Canadian zones, where they

breed (Saunders, 1921: 154). In this study they were found on Little Lake (6500 feet) and on Glacier Lake (7000 feet) at the headwaters of Rattlesnake Creek. Ludvig Browman (unpublished field notes) on a number of journeys to high lakes in the mountains of western Montana has seen the birds along the shores. L. Richard Mewaldt collected an immature female Dipper in post-juvenal molt, at an elevation of 8100 feet, from the McCalla Lakes in the Bitterroot Mountains of Montana on August 10, 1947 (specimen in the Montana State University Zoological Museum). These observations are suggestive of nesting at this elevation.

During the cold periods in the fall and winter Dippers are found in open water of streams and rivers in lower valleys (Lundwall, 1915; Skinner, 1922; Bergtold, 1924). Nelson (in Bent, 1948: 111) indicates that some Dippers endure temperatures of  $-50$  to  $-60^{\circ}\text{F.}$ , and possibly lower, in the Yukon. The temperature along Rattlesnake Creek has fallen as low as  $-33$  to  $-40^{\circ}\text{F.}$  without noticeable effect on the birds, except for an increase in the period of inactivity and their restriction to unfrozen stretches of stream where food is available.

#### GENERAL BEHAVIOR

*Swimming and diving.*—Various authors have reported that the Dipper uses its wings when underwater (Bryant and Bryant, 1915; Bond, 1938; Hann, 1950). Michael (1938: 185), however, says that the bird uses only its feet underwater. My observations have been that Dippers may walk submerged along the stream bottom in shallow, relatively quiet, water with no apparent wing assistance. However, in most instances, they actively use their wings underwater. Recently Goodge (1959: 7-12) has determined through photography that a captive Dipper used the wings in swimming under water.

When diving from the surface the wings are thrown out and slightly to the rear and with a quick dip the bird enters the water head first. Frequently the birds swim on the surface against the current, or often with the current in shallow water, feeding as they move from one rock to another or stopping near the bank. When swimming the legs are used in a paddling motion.

The time the Dipper spends underwater may be exaggerated, as reported by Muir (1894: 284) and Surber (in Bailey, 1928: 533). On many occasions I have watched Dippers dive, and have occasionally timed such dives, which usually were only 5 to 10 seconds in duration, but sometimes were as much as 15 to 20 seconds.

Deep dives as recorded by Henderson (1908: 2) and Bent (1948:

97) are probably uncommon. Dippers that fed in water 15 to 18 feet deep behind the Montana Power Dam in the Rattlesnake Creek made no attempt to dive to the bottom. They picked off grubs from the concrete sides just at or slightly below the water level or skimmed food from the water surface. On May 4, 9, and 20, 1956, parent birds were seen diving almost directly below their nests into the torrential currents. It was estimated that three feet was about the maximum depth reached by the birds. On November 9, 1956, one of two feeding birds was observed diving to the stream bottom behind the dam where the water measured four feet in depth. The dive took 15 seconds, and with its buoyancy the bird bobbed up onto the surface of the water at the end of the dive. This was the deepest dive recorded, but ordinarily the birds dive to a depth of from one-half to two feet.

*Flight.*—Hann (1950: 52) has reported that the Dipper usually follows a stream closely, only a few feet above the water, although Skinner (1922: 19) saw one bird flying at a maximum of 30 feet above the surface. I have found that they commonly fly within two or three feet of the water. On July 18, 1956, two birds were found drowned, tangled in the bottom of a mist net left up overnight. Because the net bottom was set at the water level this may indicate that the birds fly very close to the water under natural conditions, *i.e.*, when not being chased by man. However, when a bird is driven from its territory it will frequently turn back and fly up and over the observer's head, if he is standing in the stream. On longer journeys down the stream Dippers may fly between three and six feet above the water. When a bird accidentally hits a mist net without being trapped it will usually fly over or around the net on the second or third attempt. At this time it may fly ten feet above the water.

The Dipper is rarely seen over land. On April 14, 1956, two birds displayed courtship behavior, the male pursuing the female. They both flew inland 30 feet and about 15 feet over my head. On another occasion a bird flew across about 10 feet of land from one stream branch to another. However, Skinner (1922: 18) saw one Dipper flying across a quarter-mile stretch between two streams.

*Grooming and resting.*—On many occasions Dippers have been observed preening and grooming their feathers. This was especially true after trapped birds were released. It is almost inevitable that in their attempts to escape from the mist net or hand, their feathers get displaced; after release they quickly fly to a rock and spend from five to ten minutes preening themselves after which they may rest or resume foraging. One behavior pattern observed in the Dipper is

the stretching of one wing fully above the head. This was seen only during the summer. It may be connected with juvenile feather development and with post-juvenile molting.

In the early part of this study it was noticed that the birds had more frequent periods of inactivity during very cold weather. The longest observed resting period during the winter of 1955-56 was ten minutes. On January 16, 1957, the temperature was between zero and 5°F. throughout the day and a study was made on the activity of the birds. Extensive areas of the stream were frozen over. Three out of four birds observed were standing motionless in shallow water when approached. I was able to move within 15 feet of the three birds before they became active. In contrast, on warmer days the birds generally became aware of the observer when about 30 yards from him. This cold temperature behavior was also observed by Robert Hoffmann (unpublished field notes) on March 9, 1956 (temperature 10-15°F.). I have observed the Dipper resting on a rock or occasionally a piece of driftwood, on one leg on six different occasions. At this time the other leg is well hidden among the breast and wing feathers and cannot be seen. They were timed in this position for ten minutes.

*Food habits.*—On Rattlesnake Creek small fish apparently supplement the diet of the Dipper. On six occasions predation on fish ranging from two to three inches in length was observed. There are no salmon in this part of Montana and the birds prey instead on small cottids or trout. The total effect of this predation is probably economically insignificant in this area.

A gross survey of available food was made on one small portion of the stream 0.25 mile below the Montana Power Company dam in May, 1956 (fig. 1). Numerous Plecoptera and Ephemeroptera nymphs and Tricoptera casings were found attached to the rocks. The sandy substratum contained mostly Tipulidae larvae and some Tricoptera. Often the food particles on which the Dipper is feeding are too small to be identified, but frequently a bird has been observed foraging upon both Plecoptera and Ephemeroptera nymphs, which they pick from submerged rocks with great rapidity. On September 13, 1956, a bird was seen with a Tricoptera casing in its bill. It picked off the outer shell and ate the larva. This was the only observed instance of Tricoptera in the diet.

An analysis of the digestive tract of two birds trapped on July 18 was made (see p. 193). No recognizable food was found in the female. In the male, one unidentified, intact, adult beetle was found in the

cloaca. The remaining food was located only in the gizzard. This contained sand grains, 2-3 mm. diameter, which constituted roughly two per cent of the total volume, and eight pieces of oligochaetes (fresh-water segmented worms) 4-5 mm. long. The bulk of the food included adult Plecoptera or portions of them, such as wings, legs, and body segments. Some legs found with no claws were presumed to be Plecoptera. No larvae of any kind were found. The large percentage of adult forms is correlated with the abundance of flying insects found on the stream during July. These are obtained either by skimming them from the water surface or by "fly-catching."

On October 13, 1956, a bird was observed eating what appeared to be moss off of a rock, and leaves from an unidentified monocotyledonous plant at the stream edge. It is not known whether this bird was a juvenile or adult as the two are almost identical after the post-juvenile molt. Bryant and Bryant (1915: 99) observed a juvenile pecking at lichens and moss in rock crevices shortly after leaving the nest. My observations indicate that fledged birds will peck at many miscellaneous objects during the first few days.

*Feeding behavior.*—Typically a Dipper picks up an aquatic nymph, crushes it, doing this sometimes with an up and down motion of its bill, and then swallows it. On three occasions birds were seen catching fry and swallowing them whole. One of these swallowed the fish immediately, another picked some scales off and then swallowed it, and the third pounded the fish on a rock for about five minutes, picking bits of muscle off intermittently, and then swallowed the remainder. Three other birds were observed to repeatedly slam their fish against a rock, pull muscle and intestinal contents out, and discard the remainder.

Dippers have been observed rapidly plunging their bills and the anterior part of their heads, including the eyes, into the water. For some time it was not known what the birds were doing, but on October 24, 1956, a Dipper was seen lowering its head in this manner and picking nymphs from the rocks. At other times they may be looking underwater for food as suggested by Burcham (1904: 50). On two separate dates, January 2 and February 19, 1956, birds were observed picking litter off the rock they were standing on and tossing it into the water. The litter consisted primarily of dead leaves. This may be related in some way to their habit of feeding on rock-clinging nymphs.

Another method of obtaining food is by "fly-catching." The bird commonly stands on a rock above the water, suddenly flies into the

air, snatches an insect, and returns to a rock (not necessarily the same one). The flight into the air is low, being well under ten feet above the stream. Birds were observed "fly-catching" on July 19, July 21, and August 17 in 1956. During these times there was a profusion of insects over the stream.

*Defecation.*—The presence of an observer at first causes a dipping action in the bird. This is followed by a quick defecation on the rock on which the bird stands and a rapid flight from the source of disturbance. Defecation in flight was observed only after banding; three birds defecating immediately after their release. On one occasion a banded bird defecated while being held.

Another stimulus which causes occasional defecation is the territorial fight. Several defending birds were seen to defecate on rocks. Other evidence for deposit on rocks can be seen on the rocks themselves, which in the territory of the bird are splattered with excreta.

*Dipping.*—One of the fundamental behavior patterns of *Cinclus mexicanus* is the dipping habit. Because dipping is so evident the name "Dipper" has been used recently to a greater extent in the literature than "Water Ouzel," which is a common name also used for the European species (*Cinclus cinclus*). Many people of western Montana use the name "Teeter-bird," etc. This name may be misleading, as the bird does not teeter or wave the tail up and down like the Spotted Sandpiper (*Actitis macularia*), but conspicuously bends the legs so that the entire body moves up and down in about the same horizontal plane.

Steiger (1940: 12) makes the suggestion that dipping is a device for communication. This is, however, unsupported. He also mentions that old birds do not dip as frequently as the young. I find no evidence of this, but there is, in general, much variation in the habit. Dipping begins at a very early age. It was not seen in nestlings 13 days old but by the 17th day the bird dipped slowly after being handled. Observations indicate that dipping is most frequent when the birds have been disturbed and is rare when they are feeding or resting. It is apparent that by the time most people get close enough to observe the bird it has already become aware of their presence and dips frequently.

*Perching.*—The Dipper is seldom seen perching. Drew (1881: 87) reported that he saw a Dipper perching in a bush. Occasionally they may be seen perching on driftwood or sharp angled rocks, but on September 11, 1956, the opportunity occurred to observe three birds perching simultaneously. A large tree had fallen and this exposed

the intricate root system over the water. Three birds were feeding together. They gradually moved near the base of the tree. One climbed up some roots which were hanging in the water and stopped about three feet above the water balancing precariously for several seconds. Then it fell directly into the water. A second attempt was made and the other two birds followed. This time the first bird climbed only a foot over the water, the other two nearby. For the following two or three minutes they would fall occasionally and climb again. Then they terminated this activity and resumed feeding.

*Mortality.*—One observation indicates that older nestlings may be able to avoid being dashed to death in torrents when they leave the nest. On May 15, 1957, nest I was checked for nestlings which were expected to fledge that day or the next. Upon seeing the observer's hand three nestlings flew out of the nest. One flew across the stream, another upstream and then entered the water. The third dropped into the water near the dam spillway (fig. 1). It paddled vigorously, but exhausted itself after one-half minute and was swept over the dam in the large volume of the overflow. After being tossed about in the stream at the base of the dam for about 20 yards, it quickly swam to some rocks at the stream edge, apparently unharmed. Just after leaving the nest, fledglings seem to allow closer approach than adults; this could be advantageous to a predator.

On September 7, 1956, an adult bushy-tailed woodrat (*Neotoma cinerea*) was found in nest IV (fig. 1). It had constructed a cup-like nest out of the moss and grasses of the old Dipper nest. The animal had remarkable climbing ability and experienced little difficulty in scrambling over a slight overhang after being chased from the nest. There is no evidence that the woodrat is a predator. They can, however, be considered as a potential threat.

#### BREEDING BEHAVIOR

*Singing.*—The Dipper is one of the most colorful singers in the whole array of Oscines. The bird characteristically has two main types of vocalization, the "alarm" or "disturbed" call note and the winter or spring song. These have been described (Ehinger, 1930; Peterson, 1941).

Throughout 1956, the alarm note was most frequently heard. Fairly close approach to the bird by the observer can be expected to elicit this call. This is especially true if the bird has been previously flushed. On several occasions a parent bird with young was seen to be quite disturbed after noticing the observer in the vicinity. In one instance the parent, after being chased, settled on a rock and gave

repeated alarm notes for a period of five minutes, waning until it observed movement, and then recommencing. This was probably due to the presence of a fledgling which was only 20 yards from the parent.

Dippers were most often heard singing while on a rock in the stream. Skinner (1922: 19) says that the birds prefer to sing on warm days but will sing on the coldest. However, I have detected no preference with respect to temperature. In 1956, songs were heard on 27 different occasions. These ranged from a few disconnected sounds to very brilliant, vociferous singing that continued for a full 10 minute period and could be heard for several hundred yards. In 1957, from January through April, songs were heard on 22 different occasions. Singing was intense during this period and on March 17 a bird sang repeatedly for at least 20 minutes.

Singing was strong during January, 1956, increased in intensity through February and March and reached a peak in April. From December through February both males and females sang so similarly as to be indistinguishable. The male sang very loudly when in the presence of a female during the pairing stage. No singing was heard during the incubation period but it was resumed by the male parent during the nestling and fledgling stages. However, the observer's whistle elicited a short song by a male Dipper on one occasion during the incubation period in 1957. No singing was heard from June 6 to September 11, 1956. From this latter date on, the number of songs heard and their intensity slowly increased until the latter part of November at which time a more rapid increase in singing was noticed. The winter and early spring seasons of 1957 were very similar to those of 1956.

*Pairing, courtship, and copulation.*—The first observed pairing of birds in the spring of 1957 occurred on March 9. An unbanded male Dipper was heard singing loudly for 10 minutes. Bird #7, a male, approached him and both assumed a territorial defense posture (see below). Then the unbanded male, with wings bent downward, shook them rapidly, reminiscent of involuntary shivering in man when cold. A third Dipper approached and all three birds walked in a two-foot circle while maintaining territorial defense postures. The third bird, presumably a female, had been observed with #7 before he approached the singing male. Next, #7 chased the male 50 yards upstream, the female following behind. All three birds returned downstream several minutes later. The unbanded male sang very loudly and shook his wings. Number 7 then shook his wings and gave a

repeated alarm call. The female stood off to one side and watched the display. The chase resumed again as #7 pursued the male upstream and the female followed them. This behavior continued for another 30 minutes. The unmarked male and female were banded (#23 and #24) but their sex could not be determined at the time of marking. Number 7 flew over the mist net and on downstream to the vicinity of nest II (fig. 1).

It seems evident that #7 and the unbanded female were already paired before the engagement with the unbanded male. Territorial defense was very strong with even the female taking a defense posture on one occasion. This would indicate that there is a period of time during the early spring when a transitional change occurs from strong winter defense behavior (see below) to the paired condition. During this time, even the birds of the same pair may show a defense behavior toward each other on occasion. This particular behavior between two males in the presence of a female not only shows territoriality but is highly suggestive of the occurrence of a courtship display.

*Sex determination.*—The only method of determining sex in the wild is to observe the distinctive nesting behavior of the sexes. However, Richter (1953: 70) has successfully sexed the European Dipper or Water Ouzel (*Cinclus cinclus*) by measurements of wing lengths. He found that all birds with wings measuring under 89 mm. in length were female, all those 90 mm. and above were males. This method was checked for accuracy by observing the breeding behavior of measured and banded birds and could be first used on six to eight week-old juveniles. This system has not been employed in determining sex in the American Dipper (*Cinclus mexicanus*) so far as is known.

On April 14, 1956, a pair of birds from the vicinity of nest I (fig. 1) was seen in a courtship display in the stream area behind the Montana Power Company dam. The male chased the female for a total period of about 10 minutes. The male flew repeatedly from a small concrete block near the shore, where he would take brief rests of about 5 to 10 seconds, to the female which was in shallow water near the stream bank. Occasionally, when he would rest for 15 to 20 seconds, the female would fly past the male on the concrete block, apparently stimulating the male quickly to resume his chase. Flying at high speed, for Dippers, they would twist and turn while maintaining a fairly straight overall flight path. The male was singing loudly while pursuing the female. Often when the male was in pursuit, the female would drop into the stream with the male flying on rapidly over her. This behavior occurred within a 50-yard length of stream.

From my observations copulation in the Dipper is an event which

usually takes place from two to four weeks after the birds have formed paired associations. This interesting behavior is not frequently seen or reported. The mating behavior observed resembles that noted by Ehinger (1930: 494). The pair of birds observed on April 14, 1956, occasionally met in midair during the courtship flight, the male's breast and female's back in close contact. This behavior suggests copulation in flight; however, it may have been a type of courtship activity. On one occasion they thus met in air about 15 feet above the water and then fell in a free drop together into the water.

On May 23, 1956, two birds were seen copulating in the vicinity of nest IV (fig. 1). One was in shallow water on a sand bar and the other was standing on its back performing an up and down patting motion with its feet. The cloacal regions came in contact for about 15 seconds. This was repeated three or four times within about two minutes. Before alighting on the sand bar both birds were seen flying at high speed. This suggests that some chasing had taken place before copulation.

*Nesting.*—In the present study, all nests had an outer shell constructed of moss with small amounts of interwoven grass stalks and roots. The inner lining consisted largely of dry grass stems arranged into a cup-shaped structure. Several dry cottonwood leaves were found in the inner bowl just before eggs were laid in nest I on April 1, 1957. The entrances measured about three inches wide and two inches high during the early stages of nesting but became four inches wide and four inches high by the end of the nesting period. On several occasions one of a pair of birds was observed with moss in its bill. On March 6, 1957, at nest III and on April 20, 1957, at nest VII, both male and female repaired or constructed the nest. Bent (1948: 100) was told by Aretas Saunders that, in Montana, some Dipper nests are built on rocks without a bottom or lining and the eggs are then deposited on the rocks.

Hann (1950: 52) describes two common characteristics of Dipper nests, saying that they are placed over or nearly over the edge of a stream and are mostly inaccessible. I am in full agreement with Johnston (1943: 65), who states that the location of the Dipper nest "is determined solely by habitat conditions." The Dipper will construct nests on a large variety of supports providing that they simulate the conditions as outlined by Hann. The length of time that the nests are usable is indicated by observations of Towne (1904: 109) who photographed a nest in 1897 and found it intact in 1904, a period of seven years. If this nest was used each year then it was probably

repaired annually. On the Rattlesnake Creek usable nests are repaired each spring by the addition of moss and grass before being utilized once again. The most obvious repair is to make the nest opening smaller and to add a new inner lining.

Six nests were located during the pre-nesting period of 1956. On April 5, 1957, another nest was discovered in the process of being newly constructed. In July, 1957, a trapper informed me of an eighth nest (table 1). The nests were numbered in the order they were found (fig. 1). Three of the nests remained green during the breeding period.

TABLE 1  
NESTS WITHIN THE STUDY AREA

Nest	Location	Height above water in feet	Miscellaneous Comments
I	4.3-mile point. On wood shelf above dam spillway.	7	Used for several years prior to and including 1956-57.
II	4.4-mile point. Rocky niche.	15	Used in 1956-57.
III	6.0-mile point. Rocky niche.	5	Used in 1956-57.
IV	6.0-mile point. Rock ledge in a dark recess.	7	Used only in 1956. Atypical shape with opening from the top.
V	13.0-mile point. Crossbeam under bridge.	8	Used once but no eggs were laid. Missing in May, 1957.
VI	4.35-mile point. Rocky niche.	8	Collapsed. Not used.
VII	0.9-mile point. Crossbeam under bridge	8	Newly constructed in 1957.
VIII	4.7-mile point. On bridge.	15	Found collapsed on May 4, 1957. Newly constructed and used in 1957.

Six additional nests were found in the eight miles beyond the study area in steep granite canyons in September of 1956. Five of these were placed in exposed granite niches. One was behind a waterfall. The nests were placed about 8, 8, 14, 6, 20, and 10 feet above the water, respectively. Five of the nests would be accessible only by rope from above. The depth of water under the nests was estimated to vary from 4 to 10 feet or more and at this time the water level was very low. Three of the nests were green. Four appeared to be in use.

Nesting begins in April (Grinnell and Storer, 1924: 546) or May (Saunders, 1914: 142) and extends through June and July or sometimes even up to August in Montana (Saunders, 1921: 154). In 1956, the first egg was laid on April 15 in nest I, about April 17 in nest II (calculated), and about April 12 for nest III (calculated). In 1957, nest I had an egg laid in it on April 1. Nests II and III had eggs laid in them between April 8 and 20 in 1957.

In 1956, an inner lining was placed in nest III at least 15 days prior to egg laying. Bird #6, in 1957, was observed placing an inner lining in nest I seven days prior to the laying of the first egg. In 1957, eggs were found about two weeks after the inner lining was placed within nest III. Because young juveniles were observed in September above the study area the nesting season must have extended into July at the higher altitudes (see p. 192). Henderson (1908: 2) says that this variation in the time of nesting is partly due to differences in altitude. Young juveniles were seen as late as September 5, 1956. They were found upstream above the study area, on the West Fork of Rattlesnake Creek.

A Cliff Swallow (*Petrochelidon albifrons*) was observed in nest II on July 25, 27, and 29, 1956. She had constructed an inner lining of what appeared to be white remiges (at least around the nest opening) and may have laid eggs, although no further observations were made to determine this. This was the only instance in which a Dipper's nest was occupied by another species of bird.

*Incubation and care of nestlings.*—Most of the observations on nesting behavior in 1956 were made at nest III. Some additional information was gathered at nests I and II. During and after the inner lining was placed in nest III the male sang loudly in 1956 and 1957. In 1956, the male of nest III was not seen for a period of 22 days after the calculated egg-laying date. Again in 1957, the males were not observed around nest I or III during the incubation period. However, after incubation in 1956, the male parent of nest III was heard singing loudly near the nest while the female fed the nestlings. The males do not incubate.

During the first few days of incubation the inattentive periods vary from 8 to 22 minutes, according to Hann (1950: 54). In 1956-57, at nests I and III, the female was observed in the nest on the majority of days when checks were made during the incubation period.

The feeding of the nestlings is done primarily by the female parent, but the male (#7) alone was observed performing this task at nest II after the female had disappeared. A similar situation is reported by Hann (1950: 51). During one observation the shortest time required by the adult to obtain food was 20 to 30 seconds, and 5 to 10 seconds to feed the nestlings.

When the Dipper nestlings were 12 to 13 days old they would cry every time the parent approached the nest. The same reaction was elicited when a hand was placed over the nest entrance. While nestlings were being marked the parents did not seem to be overly dis-

turbed, but if the young cried the parents would suddenly act greatly alarmed. At about 20 days of age, two or three nestlings would stick their heads out of the nest opening until the parent arrived with food, at which time they would cry. The nestlings defecated out over the rim of the nest, as reported by Cordier (1927: 171).

Hann (1950: 53) concludes that the incubation period of the Dipper is 16 plus or minus one day. In April-May, 1956, the female (#6) of nest I incubated eggs for at least 14 days. On April 1, 1957, the same female laid her first egg in nest I, two days later her second, then one per day until four were laid. Incubation began after the fourth egg was laid and extended over a period of 16 days. In 1956, nestlings remained in nest I at least 20 days but not more than 29 days, and at least 19 days in nest III. In 1957, nestlings remained in nest I for 24 and 25 days.

*Productivity.*—Numerous authors (Mitchell, 1898; Saunders, 1921; Dawson, 1923; etc.) mention that some Dippers raise two broods per season. Drew (1881: 86) provides the only observation on this point. He found a nest with four young, the female parent of which was building another nest while the male fed the young brood. The second brood had two eggs. More recent evidence by Hann (1950: 59) and the present study show that only one brood is raised ordinarily. Table 2 is a summary of productivity observed on the study area in 1956 and 1957. No broods were raised in nests IV and V in 1956. On May 16, 1957, nest III was checked but no nestlings nor remnants of shells were found. The inner lining was still within, and no birds were observed in the area. The cause of these nesting failures is unknown.

TABLE 2  
SUMMARY OF PRODUCTIVITY

1956	Nest I	Nest II	Nest III	
No. of eggs	5	?	5	
Nestlings observed	5	3	5	
No. of nestlings that disappeared	3	?	0	
No. of nestlings banded	2	0	5	
Fledglings observed	2	4	4	
1957	Nest I	Nest II	Nest III	Nest VIII
No. of eggs	4	?	5	?
Nestlings observed	4	3	0	4*
No. of nestlings that disappeared	0	?	—	—
No. of nestlings banded	4	0	0	0
Fledglings observed	3	0	0	0

\* Reported by a trapper. Nest observed; information considered reliable.

It may be that breeding Dippers return to their previous nesting site over a period of several years. Bird #6 nested in nest I in 1956 and 1957 but had different mates each year. Bird #7 (male) remained in the area of nest II in 1956 and 1957 and may have had different mates each year, however, no proof of this exists as neither of the females were marked. It is not known whether the same birds returned to nest III in 1957 as they were not banded.

*Fledgling behavior.*—The period of time that the fledglings remain with the parent is usually short. Near nest I in 1956, the male parent (#4) was observed feeding the two fledglings, #13 and #14, 12 days after they had been fledged. At nest II the family unit, composed of the male parent (#7) and four fledglings (see p. 202), remained intact for at least 12 days. At nest III the family unit remained in the nesting area for only four days.

The fledglings were usually observed within 50 yards of the parent, who repeatedly obtained food for them. In typical behavior, each time the parent flew by they would cry, some fluttering their wings. Male #7 at nest II fed the fledglings at intervals of one to two minutes during one observation. Burcham (1904: 50) has observed parents feeding fledglings until October 7.

In addition to being fed by the parent, the fledglings spend many hours resting and grooming. They were observed standing motionless on one leg for 10 minute periods, and would also spend some time in pecking at various objects in a type of trial and error behavior. On one occasion two fledglings were observed pecking on a rock immersed two to five inches under water. Several times they were seen diving into deeper water but they made no attempt to enter the swifter portions of the current.

#### IMMATURE PLUMAGES

One-day-old nestlings (four observed) have sparsely scattered down on the crown and rump regions.

Two nests were observed (1956-57) with a total of 11 approximately 12-day-old nestlings. The nestlings had well defined pterylae. Each primary and secondary was extruded at least one-fourth inch from the sheath. The young still had a downy appearance, especially on the top of the head and rump. The incipient juvenal plumage was blue-gray. Their bodies were smaller than those of an adult, and the oral cavity and portions of the bill and legs were yellow. The legs appeared to be as long and thick as those of adults. The combined tarsus-middle toe length of the nestlings and adults alike varied be-

tween 50 and 60 mm. Their claws were well developed and quite sharp.

At 17 days of age the grey juvenal plumage was completely developed. A circlet, three fourths of an inch in diameter, of about 10 down feathers was seen on the crown and the rectrices were very short. The breast was pale white and grey, and the flank and crissum were a mixture of pale white and buff. Their oral cavities, commissural line along the bills, and portions of the legs were yellow, and the primaries and secondaries were tipped with pale white.

Newly fledged birds, 27 days old, were observed near their nesting site (nest III). They were generally of a slate-gray color with lighter undersides. The oral cavity was entirely, and bill and legs each partly, yellow. The juvenal plumage was well developed but retained a slight downy appearance.

Observations of three banded juveniles indicate that the post-juvenal molt takes place within about six weeks after fledgling dispersal.

#### SUMMARY

The general life history of the Dipper (*Cinclus mexicanus*) was studied on Rattlesnake Creek, Missoula County, Montana. Nestling birds were color-banded, juveniles and adults trapped and marked.

When diving Dippers used the wings to a considerable extent. The maximum time spent submerged was between 15 and 20 seconds. The deepest measured dive was four feet.

Dippers commonly flew within two or three feet of the water but on longer journeys this was increased to between three and six feet above water. Only on two occasions did a bird fly overland.

Dippers appear to feed upon Plecoptera and Ephemeroptera found on the rocks within the stream. Trichoptera larvae, fish fry, and plant food were occasionally eaten.

Defecation was frequently caused by the observer's presence and rarely occurred in flight.

The frequently heard alarm note was usually elicited by the observer's presence, but was also heard in connection with territorial defense behavior. Singing was strongest from December through early April. No song was heard from June 6 to September 11, 1956.

Pairing occurred throughout March. An intensive shaking of wings accompanied by loud singing was perhaps indicative of courtship behavior. Copulation took place from two to four weeks after the birds paired. Chasing appeared to precede copulation.

Of eight nests located, two were newly constructed, others were old

repaired nests. Some Dippers may return to the same nesting site over a period of several years. Nesting may sometimes begin in late March, and extend into July.

Observed clutch size was four to five. The incubation period was 16 days, the nestling period 24 to 25 days. There was no evidence that more than one brood was raised during a breeding season.

Fledglings remained around the nesting site from 4 to 14 days.

The post-juvinal molt took place within about six weeks after fledgling dispersal.

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MOLTS, PLUMAGES AND AGE GROUPS IN  
*PIRANGA BIDENTATA* IN MEXICO

BY EUGENE A. LE FEBVRE AND DWAIN W. WARNER

*Piranga bidentata*, the Flame-colored or Swainson Tanager, is a species occurring in Mexico and Central America as far south as western Panama. The three recognized races occurring in Mexico are *P. b. bidentata* (highlands of western and central Mexico), *P. b. sanguinolenta* (mountains of eastern and southern Mexico to El Salvador), and *P. b. flammea* (Tres Marias Islands), (Miller, Friedmann, *et al.*, 1957: 305-306; Blake, 1953: 534-535).

Among the numerous references to this tanager there has appeared no thorough description of the molt and plumage sequences, nor of the sub-adult plumage. The juvenal plumage has not been described. Ridgway (1902), limited in his treatment of this highly variable species by a lack of adequate material, based some adult descriptions on as few as two or three specimens. We have examined a total of 201 specimens collected in Mexico, of which 130 were *P. b. sanguinolenta*. This provides sufficient material for more thorough descriptions of the juvenal, sub-adult and adult plumages of the eastern race, and for comparisons with the other Mexican subspecies.

Measurements of 186 of the 201 specimens examined are summarized in Table 1. These data provide comparisons between the three races studied and the sex and age groups discussed in this paper. Of special interest are the significant differences obtained in the bill and tarsal measurements for the races *bidentata* and *flammea*, as these subspecies are not readily separated on the basis of coloration alone. All measurements given are in millimeters; wing length is on the chord; bill width is at the nostrils. Not included in this table are measurements of four Cuernavaca, Morelos specimens, and birds in juvenal plumage or post-juvenal molt. Specimens in post-nuptial molt have been grouped with adults.

The problem of determination of age groups and plumages arose as a result of field studies and collections at the Rancho del Cielo cloud forest locality (Martin, 1958) in Tamaulipas, Mexico by Byron E. Harrell, Joyce LeFebvre and Eugene LeFebvre. Another problem became evident as specimens were received on loan; there exists a confusion in specific identity between sub-adult males, females and juvenile *Piranga bidentata* and the Mexican races of the Hepatic Tanager, *Piranga flava*. Eight specimens of *P. flava* from several collections had been misidentified and were sent to us as subspecies

of *P. bidentata*. To clarify the distinction between the two species, a brief discussion of their plumage differences is presented.

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#### DESCRIPTION OF THE MOLTS AND PLUMAGES

##### *Piranga bidentata sanguinolenta*

(130 specimens: 100 males, 29 females, 1 juvenile)

Color designations in the following descriptions follow Palmer (1955) in most terms used.

##### *Juvenal plumage* (sex unknown)

The juvenal plumage may be described briefly as streaked on the head, back and undersides. It is predominantly blackish-brown above and pale yellow below. Because this plumage has not been described before, we are treating it in greater detail. This account is based on one specimen, a fledgling, collected June 24, 1953, at the Rancho del Cielo.

Bill in preserved specimen light fuscous becoming pale yellow in rictal region; forehead, crown, and nape orange-yellow to buffy-yellow; shaft streaks blackish-brown giving the head a boldly streaked appearance; mantle similar except broader shaft areas and buff color accentuated; shaft streaks of rump reduced; chin and throat buff-yellow, lighter than pileum and containing some blackish-brown shaft streaks; these streaks expand near tip of each feather; breast and belly pale yellow becoming deeper yellow on crissum, breast feathers with few blackish-brown tips; sides and flanks lighter yellow with darkened blackish-brown shaft area; wings blackish-brown; primaries, greater and median primary coverts lack spots; outermost primary edged with white, others faintly edged with green; secondaries and median secondary coverts tipped with buff-yellow spot; shaft streak extends along rachis through spot to tip of feather; greater secondary coverts with straw buff-yellow spot confined to outer vane distally on each feather; spotting of secondaries and coverts more deeply colored in fresh feathers, fades to pale white or

grayish-white in older feathers; tail blackish-brown, feathers only  $\frac{1}{2}$ -inch emerged and largely hidden by upper and lower tail coverts.

*Post-juvenal molt* (6 males, 1 female)

The juvenal plumage is lost by the post-juvenal molt which replaces the entire body plumage, lesser, median, and greater secondary coverts and the tail coverts. There is no indication in the specimens before us that the primary coverts are molted. The rectrices and most of the remiges are not molted; however, one specimen indicates that the tertiaries are replaced. These feathers resemble closely the juvenal tertiaries. Thus it is easy to overlook this replacement.

The feathers of the breast are the first to be replaced. This replacement begins on the central portion of the ventral tract and proceeds both anteriorly and posteriorly. The sides and flanks are completed first. The feathers of the chin and throat are partially replaced while streakings still are present on the upper breast. Gradually the chin and throat are fully replaced and only a small somewhat oval area remains on each side of the upper breast which retains some spotted juvenal feathers. About this time, most of the feathers of the interscapulars, scapulars and rump are molted and the feathers of the capital tract are beginning to be replaced.

During the time when the breast molt is still confined to the central part of the ventral tract, replacement of the lesser secondary coverts and interscapulars begins; the replacement progresses anteriorly and posteriorly. By the time the molt on the underparts has replaced the feathers of the breast, sides and flanks, most or three-fourths of the back and rump has also been replaced.

The head is the last major region of the body to molt. This replacement begins when the underparts and back are at least three fourths through the molt. The replacement of one specimen begins evenly on the forehead, crown, and nape and proceeds from the mid-line laterally. The forehead and crown are completed at the same time that replacement of the breast is completed. The auriculars and nape are replaced last.

The time of molt occurs from late May (Chiapas) until the end of August (Veracruz).

MALE PLUMAGES

*Sub-adult plumage* (27 males)

Specimens: Nuevo Leon, April 28-June 7; Tamaulipas, March 3-June 13; Veracruz, April 12-August 31; Chiapas, March 7-June 19; Guerrero, March 21-April 14.

The post-juvenal molt results in a yellow-green to orange-yellow sub-adult plumage that, in the males, differs strikingly from the later plumages. This plumage is retained through the following breeding season; the changes in coloration found in the breeding season are due to fading and wear of feather edges and tips.

Sub-adults are essentially yellow-green to orange-yellow dorsally except for wings, tail, and broad blackish stripes on scapulars and interscapulars; ventrally bright yellow; sides and flanks more olivaceous; orange and melanin on head and under-

parts highly variable; often birds with greater amount of orange also have increased melanin in the orange areas; thus, colors darker and less brilliant. The more deeply orange-tinged specimens also show varying amounts of orange or orange-red mixed with melanin on upper back; some have brownish-orange on rump and upper tail coverts. The most intensely colored specimens have greenish edgings of wing and tail replaced by dull orange-red. Remiges and rectrices retained from juvenal plumage; outermost rectrices show small white tips on inner vane.

*Post-nuptial molt* (1 male, 3 females)

The description of this molt is based on three females in at least a first post-nuptial molt and on one male in a second post-nuptial molt. Insofar as we could determine, the progression of the molt is the same in the two age groups, differing only in the colors of the feathers. This molt sequence is essentially the same as that followed in the post-juvenal molt with the exception that the molt is complete.

Replacement of the remiges and rectrices occurs at the time when the underparts and interscapular area are already partially molted. The order of replacement on the wings starts with the lesser secondary coverts (which are the first coverts to be replaced in the post-juvenal molt) and then involves the greater secondary coverts and tertiaries in succession. It is interesting to note that as a result of the order of replacement on the wing, the median coverts which form the whitish wing bar are retained until after the lesser and greater secondary coverts are replaced. The progression of the wing and tail molt cannot be followed in greater detail because we lack adequate material.

The four specimens exhibiting this molt were all collected during October (4-27) in Chiapas.

*Adult male plumage* (66 males)

Specimens: Nuevo Leon, March 19-June 22; Tamaulipas, March 1-July 29; Veracruz, March 29-July 7; Hidalgo, April 11 and 12; San Luis Potosi, April 21; Puebla, May 17; Chiapas, February 27-October 28; Guerrero, February 10-December 25.

The first post-nuptial molt results in a mainly orange-scarlet adult plumage.

Body orange-scarlet with varying amounts of green, greenish-yellow or yellow-orange on back and rump; top of head and auriculars intensified by presence of melanin. Compared to sub-adults, ventrally similar but flanks olive-brown; wings, tail and shaft streaks of back blacker; white spots on inner vane of three outermost rectrices larger, outermost spot about one inch in length.

Ten specimens differ from the other birds in this plumage in that the scarlet is intensified over the entire bird with, in most specimens, an almost complete loss of green and yellow, and with little evidence of orange present. In these birds even the wing bars and tertial spots

are entirely or partially edged with pinkish-scarlet, and the flanks are dusky-scarlet. We are inclined to believe that this intensification of color indicates an older age class.

#### FEMALE PLUMAGES

Plumage differences between adult females and sub-adult males are not readily apparent. Dickey and van Rossem (1938: 553) likewise reported this for El Salvador specimens. When only specimens bearing data on gonads are used, the females show a plumage difference only in the presence of fewer or no orange feathers on the chin, throat and head. When all specimens marked female are considered, some females show even more orange on the forehead and crown than do some first year males. Specimens marked "female" showing this orange may be males.

It is of interest to note that in *P. bidentata* the first year males closely resemble the females while in *P. flava* this condition does not prevail; instead, the males become brighter greenish-yellow below following the post-juvenal molt and the females become dull yellowish-green.

#### Post-juvenal molt (1 specimen)

We examined only one specimen (Chiapas, May 26) which still retains part of the juvenal plumage. In this individual the colors are more intense than for the juvenal plumage described above.

#### Sub-adult plumage (7 females)

Specimens: Nuevo Leon, June 7-23; Tamaulipas, April 15-July 28; Chiapas, May 26.

Sub-adult females are practically indistinguishable from sub-adult males, and, unless representing extremes, individuals cannot be sexed by coloration. A series of sub-adult females compared to males will show more pronounced streaking on the pileum. Some sub-adult males can be separated because of the increased red in the plumage.

The plumage of seven sub-adults examined has yellow-green to olive-green on the pileum; some show orange on the forehead; forehead, crown and nape distinctly streaked with black; back streaked with black with broad central shaft areas fringed with olive-green or greenish-yellow. As the season progresses, the back, especially, fades and wears, losing most of the greenish-yellow and olive coloring, becoming rather gray-green. Underparts generally bright yellow, orange-yellow on chin, throat and upper breast; sides and flanks dark olive; wings and tail black or brownish-black, feathers edged with yellow-green except outermost primary and rectrix which are whitish-gray; tail tipping pale and limited in extent as in sub-adult males.

### *Adult plumage* (18 females)

Specimens: Nuevo Leon, March 26-June 22; Tamaulipas, March 4-July 20; Veracruz, April 3-July 2; Chiapas, May 24-October 27.

Generally the adult females can be differentiated from the sub-adult females by a very slight lessening of streaking on the head, and by the large ( $\frac{3}{4}$ -1 in.) tail spots found on the outermost rectrices.

The fresh adult plumage in two October birds shows a general addition of orange, deepest on head, chin, and throat; head streaks nearly obscured by brighter fringes; throat, breast and belly orange-yellow to olivaceous-yellow, the darker color on sides and flanks; backs remain streaked but black less extensive, largely masked by green edges of neighboring feathers; later in season wear or overlying brighter fringes results in increase of black on back and in streaking of head; white spots on the outermost rectrices as in adult males.

In another specimen taken in October and in fresh plumage the colors are more intense than those described above. Four adult females collected in the spring also exhibit brighter colors:

Pileum yellow, touched with dusky, unstreaked; back streaked, black shaft streaks fringed with bright yellow-green; rump and upper tail coverts bright green or green-olive; throat, breast and belly bright yellow.

### GEOGRAPHIC COMPARISON WITH OTHER MEXICAN RACES

The juvenal plumage and the post-juvenal molt (based on three molting specimens examined) in *P. b. bidentata* are similar to those in the race *sanguinolenta*. No specimens of *P. b. flammea* in these categories were available. Therefore, the following discussions will briefly compare the plumages found in other populations in Mexico.

Specimens from Sonora, Sinaloa, Jalisco, Nayarit, and Michoacan agree in their subspecific relationships based on coloration, and the males are easily separated from all males of the eastern race. Adult males in fresh plumage (October-February) have bright yellow-scarlet to scarlet heads, throats, and breasts. The underparts are orange or yellow-orange; the back is streaked and the wings and tail are dull black resembling those of the eastern race. By the breeding season (specimens: March-August) this plumage is faded and less brilliant dorsally, although the underparts remain much the same. The adult male differs then, from adult male *sanguinolenta* principally in lacking the intense red on the head, back and undersides, thus appearing more orange. There is less green on the back, wings and tail; the green of the back is replaced by gray-orange. *P. bidentata* has less melanin on the body, although this difference is less marked than the difference in greens and reds.

These differences in the amounts of red, green, and melanin in the plumage hold true for the sub-adult plumages as well. Four sub-

adult *bidentata* (April 25-May 1) examined are yellow-green above and bright yellow below. Compared to *sanguinolenta*, the ventral parts are more yellow and the pileum and back have more yellow and less green and melanin.

Two juvenal plumaged male *bidentata* (June 6-July 31) lack the degree of streaking which is prominent on the heads of two immature

TABLE 1  
MEASUREMENTS OF MEXICAN RACES OF *Piranga bidentata*

MALES:								
	WINGS		CULMEN		BILL WIDTH		TARSUS	
	sub-adult	adult	sub-adult	adult	sub-adult	adult	sub-adult	adult
<i>sanguinolenta</i>								
x	93.3	96.7	16.7	16.6	9.3	9.4	21.3	21.0
s <sub>x</sub>	2.2	2.2	0.6	0.7	0.8	0.4	0.2	0.7
SE <sub>x</sub>	0.4	0.3	0.1	0.3	0.2	0.4	0.1	0.1
Range	87-97	91-102	15.1-17.6	15.6-17.7	8.6-9.7	8.7-10.6	20-23	19-22
Sample	27	67	27	66	27	67	27	66
<i>bidentata</i>								
x	95.5	97.5	15.9	16.4	9.1	9.3	22.0	21.7
s <sub>x</sub>	1.1	3.3	0.3	0.7	0.2	0.1	0.0	0.5
SE <sub>x</sub>	0.6	0.7	0.1	0.1	0.1	0.02	0.0	0.1
Range	94-97	86-104	15.6-16.3	15.1-17.7	8.9-9.2	8.7-9.8	.....	21-23
Sample	4	24	4	24	4	24	4	24
<i>flammea</i>								
x	92.0	98.3	17.4	17.5	9.6	9.5	21.5	22.5
s <sub>x</sub>	...	0.7	...	0.5	..	0.1	...	0.7
SE <sub>x</sub>	...	0.2	...	0.1	..	0.02	...	0.2
Range	.....	97-101	.....	16.9-18.5	.....	9.3-10.1	.....	21-24
Sample	2	15	2	15	2	15	2	15
FEMALES:								
<i>sanguinolenta</i>								
x	94.1	94.2	16.3	16.6	9.3	9.1	20.1	20.4
s <sub>x</sub>	2.4	2.6	0.8	0.7	0.2	0.5	0.7	0.4
SE <sub>x</sub>	1.0	0.6	0.3	0.2	0.1	0.1	0.3	0.01
Range	91-97	91-100	15.3-17.3	15.2-17.8	8.9-9.8	8.0-9.7	19-21	19-22
Sample	7	21	7	20	7	21	7	20
<i>bidentata</i>								
x	93.6		16.8		9.3		20.5	
s <sub>x</sub>	2.1		0.4		0.1		1.0	
SE <sub>x</sub>	0.7		0.1		0.04		0.3	
Range	88-97		16.0-17.7		8.2-9.8		19-22	
Sample	11		11		11		11	
<i>flammea</i>								
x	92.0		17.8		9.7		21.8	
s <sub>x</sub>	2.3		0.6		0.1		1.0	
SE <sub>x</sub>	0.8		0.2		0.5		0.3	
Range	88-95		17.0-18.4		9.4-10.5		20-23	
Sample	8		8		8		8	

specimens of *sanguinolenta* from Tamaulipas and Veracruz. The underparts likewise are less heavily spotted compared to juveniles of *sanguinolenta*.

Males of *flammea* (Tres Marias Is., March 7–October 24) resemble *bidentata* in coloration, except for the degree of spotting on the undersides of the lateral rectrices. Ridgway (1902) described the race *flammea* as being distinctly larger in size than *bidentata*, but this obtained only in his total length measurement. We did not measure total length but found the two races differed significantly (5% level) in massiveness of bill; this difference is apparent in bill measurements summarized in Table 1.

As in *P. b. bidentata* the sub-adults of *flammea* may be described briefly as yellow-green above with bright yellow underparts. Two males (May 2–11) and eight females (date and age unknown) are indistinguishable from each other, although one of the males does have more orange on the head and throat than do any of the other specimens. The two males are badly worn and fading is evident.

Comparison of female *bidentata* with *flammea* shows great similarity in plumage coloration; no consistent difference is evident except in size (Ridgway, 1902 and Table 1). Both differ from *sanguinolenta* in that the underparts are bright yellow, lacking the dusky or orangish colors which are found on the breasts and flanks of *sanguinolenta*. The head and back of *sanguinolenta* have more melanin and again show more green (less gray) than do the two western races.

The juvenal female in *sanguinolenta* (this specimen is partially molted) is somewhat darker on the flanks and has slight orange tinges on the breast. The head is more heavily streaked than in the western subspecies.

*Cuernavaca specimens* (4 specimens)

Four specimens from Cuernavaca, Morelos are sufficiently different in plumage coloration to merit separate description; however, no attempt is made at this time to separate these birds from the western race because an adequate number of specimens is lacking to substantiate such a change. Of these, one sub-adult male (February 16), when compared to other sub-adult *P. b. bidentata*, has darker orange to orange-yellow feathers on the head with an increase in melanin. The change in color from the nape to the back is abrupt, forming a definite crescentic line at this point (accentuated somewhat by the method of preparation). This character is also true for one sub-adult female specimen (February 16). The back is much darker than it is in the other representatives of this race showing wider black central areas in each feather, the edges of these feathers are light yellow-green on the anterior region of the back becoming whitish to whitish-gray on the posterior feathers. The tail feathers are brown apparently because of fading; the white area on the rectrices is only one-half to three-fourths inches long. The wings are similar to those for the rest of the race.

Two adult specimens (February 10 and 11) from Cuernavaca differ slightly from the other adult *P. b. bidentata* examined. The range of colors of the head, throat, breast, belly and rump falls within those described. The forehead has a few bright scarlet feathers in one specimen. The line of demarcation between the nape and the back is prominent as noted for the sub-adults. The back feathers have edges of orange-olive and greenish-orange; but there is a light grayish appearance when compared with other specimens of *bidentata*.

#### COMPARISON OF *Piranga bidentata* WITH *P. flava*

*Piranga flava* specimens: Michoacan, 2 juveniles, May 17, 4 post-juvenile molt, July 1-31; Guerrero, 4 post-juvenile molt, June 21-Sept. 1; Morelos, 1 juvenile male, April 26, 1 post-juvenile molt, June 10, 1 adult female, August 13; Chiapas, 1 adult male, August 29; Veracruz, 1 post-juvenile molt, August 7; Arizona (Santa Rita Mts.) adult female and male, June 25; (Huachuca Mts.) adult female and male, July 24 and July 1; New Mexico, adult male, May 7.

Since the identity of some age and sex groups between the Flame-colored Tanager, *Piranga bidentata*, and the Hepatic Tanager, *P. flava*, has been confused, a review of the plumage differences between the two species is desirable. Adult males are seldom confused; the orange-red *P. bidentata*, with its white wing bars, tail spots, and dusky-streaked back, is easily distinguished from the less intensely colored *P. flava*. Zimmer (1929) has discussed the molts and plumages of *P. flava* in greater detail. The following comparison of the juvenile stages is based on an examination of the one *bidentata* fledgling, previously described, with thirteen juvenile *flava* from Mexico, three fledglings in juvenile plumage, and ten birds in post-juvenile molt. (The points of difference from *P. bidentata* apply to both Mexican races of *P. flava*: *P. f. hepatica* and *P. f. dextra*.)

The dark centers on the feathers of the top of the head and back in the juvenile plumage of both species give the bird a streaked dorsal appearance. The general dorsal coloration of *P. flava* is darker and is an olivaceous-brown fading to grayish-brown. The dorsal aspect contrasts with the *pale yellow head streaked with black* and the yellowish to rich buff back of *bidentata*. The underparts of *flava* are *pale yellow boldly streaked with black or brownish-black*, while in *bidentata* the breast and belly are very pale yellow to whitish and have light streaks largely confined to the breast. The tertiaries in *bidentata* have large white spots which are not present in *flava*. The edges of the outer vane of the primaries and secondaries are brighter in *flava* than in *bidentata*. The tail in *flava* is *brown edged with bright orange-yellow-green, and the complete lack of white spots* easily distinguishes this species from *bidentata*.

An adult female and a sub-adult male *P. flava* collected in August

have a green aspect to the dorsal appearance. The back is plain and unstreaked, and lacks the bright yellow-green or orangish edging commonly found in *bidentata*, as well as the white tail spots and wing bars of that species. Ventrally, the immature males and all females of *bidentata* are brighter yellow and less olivaceous than are birds of similar age groups in *P. flava*.

#### SUMMARY

The molt and plumage sequence of the three Mexican races of *Piranga bidentata* was determined from 201 specimens. Differences between the sub-adult and adult plumages in each subspecies and among the subspecies are described, and the juvenal plumage of *P. b. sanguinolenta* is described for the first time. Measurements of the Mexican races are presented. In addition, plumage differences between *P. bidentata* and *P. flava* are pointed out.

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THE IMPORTANCE OF JUVENILE CANNIBALISM IN THE  
BREEDING BIOLOGY OF CERTAIN BIRDS OF PREY

BY COLLINGWOOD INGRAM

For the majority of birds it is manifestly of considerable importance to synchronize, so far as is possible, the hatching date of their eggs. Indeed, this is essential if the entire brood is to leave the nest at approximately the same time, which, in most species, is necessary if they are all to survive. The approximate synchronization of the hatching date is, of course, normally effected by postponing full-time incubation until the clutch has been nearly, or wholly, completed; but it may be further assisted if the more recently laid eggs require a slightly shorter time to hatch than those deposited earlier (See Jourdain, in Witherby *et al.*, 1: xxi; 1938).

As a uniform hatching date is indubitably a desirable feature in the breeding biology of most birds, why is it that with the majority of raptors there is no synchronization in the hatching of the clutch? On the contrary with many of them, intervals of one, two, or more days commonly occur between the birth of each nestling. In large-brooded species, since incubation usually starts with the first egg laid, this may even result in differences of a fortnight or more between the ages of the first and last hatched nestling.

What are the advantages gained by graduating the ages of their young in this way? I suggest, at any rate so far as the larger-brooded raptors are concerned, that the habit is beneficial for the following reasons. First, by "staggering" their ages, the task of sustaining a large and growing family of carnivorous young, instead of becoming progressively more difficult and perhaps ultimately impossible, is simplified, and to a great extent eased, by being spread over a prolonged period. And, secondly, as it is eugenically preferable to rear, let us say, one or two healthy well-nourished progeny rather than six or seven weaklings, this "staggering" is of the highest importance since it offers perhaps the only satisfactory way—namely by controlled cannibalism—of numerically reducing the family to a feedable size when this has become vitally necessary owing to a food shortage. As the food supply of some of the owls—and this is especially true of *Asio flammeus*—is often largely dependent on fluctuations in the population of certain rodents, a ready and rapid means of adjusting the size of the brood to the amount of food available is clearly desirable.

Without a marked disparity in the age and size of the fledglings, fratricide would be virtually impossible and consequently no such

rapid adjustment could take place—hence the need for “staggering” their ages.

This very interesting phase in the life history of many raptors has been largely neglected by ornithologists and in consequence literature on the subject is somewhat meagre. Except for a short paper by Wendland (1958), the survival value derived from the elimination of redundant fledglings appears to have been ignored, even when juvenile cannibalism has been mentioned.

This dearth of authentic records is perhaps understandable, for should a nestling disappear unaccountably from a nest that is being watched, the observer will almost certainly presume that, after death from lack of food or some natural cause, its body has been removed by one of its parents. That was apparently the conclusion arrived at by A. A. Saunders (quoted by Bent, 1937: 82) when he found that the two youngest members of a brood of Marsh Hawks (*Circus cyaneus hudsonius*) had inexplicably vanished from a nest. Two days before this discovery he had remarked that the oldest birds were about three times the size of the latest hatched nestlings, which were, of course, the ones that had disappeared. Failing detection *in flagrante delicto*, which is extremely unlikely, it is only when the remains of a body—usually the beak and part of the skull—has been actually found in a nest or in one of the nestling's castings, that cannibalism can be definitely established, and such discoveries are necessarily very few.

Thus, although circumstantial evidence indicates that fratricide (which apparently is almost invariably followed by cannibalism) occurs, either commonly or occasionally, in most birds of prey, I have come across what seem to me convincing records only in the following species:

Common Buzzard (*Buteo buteo*); Rough-legged Buzzard (*Buteo lagopus*); Swainson's Hawk (*Buteo swainsoni*); Red-tailed Hawk (*Buteo jamaicensis borealis*); Red-shouldered Hawk (*Buteo lineatus*); Golden Eagle (*Aquila chrysaetus*); Bald Eagle (*Haliaeetus leucocephalus*); Kestrel (*Falco tinnunculus*); Lesser Spotted Eagle (*Aquila pomarina*); Verreaux's Eagle (*Aquila verreauxi*); African Hawk Eagle (*Hieraetus ayresi*); Crowned Hawk Eagle (*Stephanoaetus coronatus*); Goshawk (*Accipiter gentilis*); Peregrine (*Falco peregrinus*); Hen Harrier (*Circus c. cyaneus*), and its American counterpart, the Marsh Hawk (*Circus cyaneus hudsonius*); Marsh Harrier (*Circus aeruginosus*); and, among the nocturnal birds of prey, in the Short-eared Owl (*Asio flammeus*); Long-eared Owl (*Asio otus*); Great Horned Owl (*Bubo virginianus*); Barn Owl (*Tyto alba*); and Philippine Grass Owl (*Tyto capensis amaurota*).

Krambrich (1954) has published a short note on a single instance of cannibalism in the Honey Buzzard (*Pernis apivorus*), but as that species is largely insectivorous this would appear to be a very unusual event, and for that reason I have purposely omitted it from my list of "convincing records."

**Buzzards.** In the Common Buzzard (*Buteo buteo*) juvenile cannibalism is of frequent occurrence, as the observations of J. H. Salter (1904) and H. A. Gilbert and A. Brook (1924) and others clearly indicate. Referring to this hawk, Salter writes—"The young are . . . hatched at intervals of one or perhaps two days. The nestling which is first hatched is naturally the strongest, and the result is frequently a family tragedy. It appears to be quite the usual thing for the first-born to kill one, if not both of his younger brothers. . . . While three eggs are frequently laid, the bird (in some districts) never brings off three young. This appears to be the case in the hills, but in the lower and more fertile valleys where food is abundant, I have known several instances in which three young were reared." That cannibalism had followed fratricide in at least one instance was definitely proved by A. Brook (1924) when he found the claw of a nestling among other remains in a Common Buzzard's nest.

Very similar observations have been made in Germany by Schmaus (1938) and Wendland (1958). The former (as quoted by Lack, 1947), states that out of fourteen nests of this species found during the years 1932-36, in only four instances were all of the young hatched successfully reared. It is of interest to note that these successes all occurred during a year when mice were unusually abundant. Wendland (1958) declares that when the population of field mice is inadequate sometimes as many as a third of the Common Buzzards hatched fail to reach maturity.

Apparently cannibalism also figures prominently in the domestic economy of the Rough-legged Buzzard (*Buteo lagopus*). E. K. Barth (1952) in the English summary of his paper on the breeding biology of that bird in Finland says "I have observed that the older and stronger young of the Rough-legged Buzzard ate the later hatched weaklings"—a statement which would seem to imply that juvenile cannibalism is normal, rather than exceptional, in that species.

Again we learn from Criddle (*in Bent*, 1937: 154) that in only one out of six nests of the Eastern Red-tailed Hawk (*Buteo jamaicensis borealis*) did the parents succeed in rearing more than one young "though more were hatched in every instance."

Although the Craigheads (1956) make no mention of cannibalism

in their book, from the statistics they give of juvenile mortality in the nests of the Red-shouldered and Swainson's Hawks (*Buteo lineatus* and *B. swainsoni*), it is evident that the practice must be of common occurrence in those two species: in both the mortality after hatching is stated to be roughly 40%.

**Harriers.** We have definite proof that cannibalism is occasionally, if not frequently, practiced among the fledglings of the Hen Harrier (*Circus c. cyaneus*), which, significantly, is one of the larger brooded raptors. David Bannerman (1956) cites the Norwegian naturalist, Dr. Y. Hagen, as having found on three separate occasions the remains of victims in as many different nests of this Harrier, and that over a period of nine years out of 102 young of this species hatched only seventy succeeded in reaching maturity. In view of Hagen's discoveries is it not permissible to ascribe at least a proportion of this heavy mortality to cannibalism? Conclusive proof that it has occurred, at least once, in a brood of Marsh Harriers (*Circus aeruginosus*) comes from J. Vincent (1936).

**Eagles.** It is difficult to understand in what way eagles, which lay only two, or at most three, eggs, can possibly benefit by the fratricidal tendencies so commonly found in their young. With most species it is apparently usual for the younger eaglet to be killed by the first born. The relentless pugnacity with which an older nestling Golden Eagle (*A. chrysaetus*) will persistently attack its younger and weaker nestmate has been described by Seton Gordon (1956) and others, while very similar behavior has been recorded by E. G. Rowe (1947) for the young of Verreaux's Eagle (*A. verreauxi*) in Africa. A. C. Bent (1937: 340-341) writing of the Bald Eagle (*Haliaeetus leucocephalus*), whose young seemingly hatch at intervals of a few days, remarks that "Although often two, and sometimes three eaglets are hatched, the larger number is seldom raised to maturity and often only one eaglet lives to grow up." Of the White-tailed or Gray Sea-Eagle (*H. albicilla*) Jourdain (*in* Bent, 1937: 315) says the smaller young is bullied and not infrequently dies. V. Wendland (1958) says that it is well known that the first hatched nestling of the Lesser Spotted Eagle (*A. pomarina*) will almost invariably cause the death of the later hatched nestmate. Between 1928-38 Wendland examined twenty-eight eyries of this eagle and of these, eleven were kept under close scrutiny. He tells us that the hatching intervals between the two eggs laid were from three to four days. The younger nestling always disappeared when from three to four days old.

Among the eagles studied by Leslie Brown (1955) in Africa, he found

that only the African Hawk Eagle (*Hieraetus ayresi*), one species of Crowned Eagle (*Stephanoaetus coronatus*), and Verreaux's Eagle (*Aquila verreauxi*) regularly laid two eggs. Out of seven cases where two eaglets hatched, both survived in only two nests. It is said that the fighting instinct in young eaglets ceases after the first few weeks and that thereafter two or more fledglings will live amicably together. I believe this to be also true of other birds of prey whose nestlings are prone to fratricide.

*Owls.* With some of the owls juvenile cannibalism is apparently a prevalent habit. Its incidence has been proved in the Barn Owl (*Tyto alba pratincola*) by the discovery of osseous remains in the castings ejected by some of the surviving nestlings (Hawbecker, 1945); while similar proof is forthcoming for the Great Horned Owl (*Bubo virginianus*) (Errington, *et al.*, 1940: 836, 844, *cf.* 794). Amadon and Jewett (1946) writing of a Philippine Grass Owl (*Tyto capensis amauronota*) nest, explain the loss of one of the two fledglings it contained as "probably eaten by the other young or the female."

My own observations suggest that juvenile cannibalism is of frequent occurrence in the Short-eared Owl (*Asio flammeus*). In regard to that species, I am satisfied that in certain circumstances, namely when there is a dearth of prey, the removal of the weaker members of the brood is not only desirable but has a definite survival value. On the other hand, in times of plenty it would, if practiced, be just the reverse, since it would then unnecessarily curtail a natural increase in the birds' population. I believe that to prevent that from happening when conditions are propitious, Nature has evolved a simple method by which the fratricidal tendencies of the older nestlings are to some extent controlled. This is achieved by the parents providing, when rodents are sufficiently abundant, a constant and easily accessible supply of surplus food for the young when hungry. This surplus, or "control" food (as I shall henceforward call it) is, of course, supplementary to that brought directly to the brood. Instead of being given at once to the fledglings this is placed at some little distance from them—usually about three or four inches from the edge of the nest. The function of this would appear to be two-fold: first, the intervening space is seemingly sufficient to deter the nestlings from eating it until impelled to do so by hunger; secondly, it restricts its consumption to the older, that is to say, to the potentially fratricidal, members of the brood, since they alone will be sufficiently developed to be physically capable of reaching it.

It was while studying the breeding habits of two pairs of Short-eared





(Above) Nest of Short-eared Owl (*Asio flammeus*), showing two larders for storing "control" food. Note the body of a field vole in one of the larders. The three youngest members of the brood have already disappeared, probably killed and eaten by their larger brethren. (Photo. by C. Ingram.)

(Below) Barred Owl (*Strix varia*) incubating on ground nest. Seven-Mile Fire Tower, Everglades National Park, January, 1957. (Photo by Fred K. Truslow.)

Owls on one of the more northern of the Orkney islands that I came to the conclusion that the distance from the edge of the nest at which the "control" food is placed is of functional importance and not merely a matter of chance. It so happened that both of these owls' nests were so closely encircled by a dense growth of coarse grass that there was virtually no space round their perimeters upon which the old birds could lay the "control" food. Consequently, to enable it to be placed at what I presume is the correct distance from the nest, the adults had in both cases been obliged to excavate a small cave, or "larder," in the surrounding wall of vegetation. These "larders" were in the form of a neatly made recess some five or six inches in depth. It was in these that the "control" food, here composed entirely of small rodents, was always placed. Incidentally, the bodies of these rodents, when more than one, were invariably laid side by side and were therefore always at approximately the same distance from the edge of the nest.

One of these Orcadian nests had been provided with two such "larders" (Plate 7 above), the other with only one. I understand where the surrounding vegetation is of a different nature and sufficiently open to allow the control food to be laid at the requisite distance on the bare ground fully exposed to view, these larders are dispensed with.

From the first of these two nests, according to the warden of the bird sanctuary who showed it to me, three owlets had previously disappeared, leaving only four survivors; from the second nest, two out of a brood of eight vanished during the first few days of my visit. Thereafter, throughout my stay on the island, no further losses were noted (Ingram, 1954).

The apparently mysterious disappearance of these five owlets can, I feel confident, be attributed only to cannibalism, since it is inconceivable that the old birds, ceaselessly on the alert, would have permitted their removal by any of the local predators, which were here chiefly composed of Lesser Black-backed and Herring Gulls (*Larus fuscus* and *L. argentatus*). In any case, had any of those birds succeeded in raiding the nests, it is very unlikely that they would have deliberately selected for their prey the smallest and least conspicuous of the nestlings, which in both cases were the ones that had disappeared.

I suggest that the subsequent cessation of these cannibalistic activities was mainly due to two causes: (a) the approximation in size of the surviving fledglings as they grew older and after the elimination

of the youngest or smallest members of the brood, and (b) the apparent rapid increase in the numbers of field voles (*Microtus agrestis*) as the summer advanced—an increase which enabled the adults to maintain a more or less uninterrupted supply of “control” food.

Kenneth Richmond (1958), writing of this species, describes a truly remarkable incident. Wishing to photograph a Short-eared Owl in natural surroundings, he erected a hide near one of their nests containing a brood of nine young. As the adults were reluctant to return to the nest while the hide was there, after waiting patiently for an hour and a half, Richmond decided to abandon his project and remove the offending hide. Before departing he counted the nestlings: there were now only six! “The discovery,” he says, “left me gaping. But this was impossible! After all, I had been watching them at a distance of only a few feet, never once taking my eyes off them for the best part of two hours. Still there it was: instead of nine, there were now only six.” Although Richmond does not attribute the mysterious disappearance of these three fledglings to cannibalism, I cannot conceive how there can possibly be any other explanation. The fact that the old birds were denied access to the nest for two hours or more apparently upset the normal rhythm of their domestic behavior. During that period, admittedly not a very long one, they were unable either to brood their young or to bring them any food—both factors which would have discouraged the cannibalistic tendencies of the larger fledglings.

In some respects, the breeding habits of the Snowy Owl (*Nyctea scandiaca*) appear to be not unlike those of the Short-eared Owl. It also builds its nest on the ground and in a similar manner lays its eggs—sometimes numbering as many as nine or ten—at irregular intervals over a long period, so that its young may vary in age and size from a half-grown fledgling, perhaps fourteen to fifteen days old, to an unhatched embryo. O. I. Murie (quoted in Bent, 1938), expressed surprise at the high mortality he found among the young of this species. He notes that “most of the broods numbering seven or eight were eventually reduced to four or five, while some were still further decimated.” Writing of the Snowy Owl in Norway, Prof. Collett (1872) informs us that “round about the nest are found mice and lemmings.” I suggest these are so placed to serve, as with the Short-eared Owl, as “control food” to deter the older nestlings from committing unnecessary acts of cannibalism.

# SUMMARY

Circumstantial evidence indicates that fratricide, in all probability invariably followed by cannibalism, occurs far more frequently among birds of prey than is commonly supposed and, indeed, in a few species is perhaps a normal, rather than an exceptional, practice.

It is suggested that, if properly controlled and chiefly confined to periods of privation (as is apparently the case with *Asio flammeus*), juvenile cannibalism has a definite survival value, and is therefore an important factor in the breeding biology of certain species, particularly in those that lay relatively large clutches of eggs.

Since juvenile cannibalism would be virtually impossible without a considerable difference in the ages of the nestlings, Nature has ensured that difference by "staggering" the hatching dates of the eggs by sometimes as much as two, three or even four days.

The significance of fratricide, so frequently observed in eagles which lay only two eggs, is not clear, since the practice does not appear to be correlated with a dearth of prey.

When food is abundant, a means by which juvenile cannibalism may be controlled is provided in *Asio flammeus* by the deposition of surplus food a few inches from the nest. This practice may also exist in *Nyctea scandiaca*.

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#### ERRATUM

'The Auk,' 76 (1), p. 107, January, 1959: In the note by J. W. Hardy on a fossil recurvirostrid, the caption to the figure (but not the figure) has the numerals 2 and 3 transposed; i.e., the words "Piece No. 2" should read "Piece No. 3" and *vice versa*.

### GENERAL NOTES

**Barred Owl Nesting on the Ground.**—On January 6, 1957, Ralph Johnston, lookout at Seven-Mile Fire Tower, Everglades National Park, sent me word that a Barred Owl (*Strix varia*) had established a nest on the ground at the foot of the tower. Despite its exposed situation, the nest was maintained until the three eggs hatched in early February, the nestlings surviving for about one week. The nest's unusual location and the extreme tameness of the parent birds gave opportunity for more satisfactory observation than is ordinarily possible at Barred Owl nests. At my suggestion, Johnston entered his daily observations in the tower log, and Fred K. Truslow devoted a number of days to watching the nest and obtained an excellent series of photographs. I am greatly indebted to Messrs. Johnston and Truslow for permission to report information that they recorded.

**Nest Site:** Seven-Mile Fire Tower is located in the open Everglades of Dade County, Florida (Section 30, Township 55S, Range 36E), seven miles south of the Tamiami Trail (U. S. Route 41) at a point about 35 miles west of Miami. The tower site is a two-acre fill enclosed by a canal, and the tower itself is of open steel frame construction 85 feet high. The nest was placed within the base of the tower behind a concrete block that forms the bottom step of the first flight of stairs. The step may have afforded some shelter to the nest at the northwest side but, because of their location and angle of ascent, the stairs provided neither overhead cover nor shade. The site had been newly mowed at the time the nest was established, and the incubating adult was in no way concealed or enclosed (Plate 7, *Below*). Bent (1938: 185) reported that Barred Owls may devote considerable effort to lining and reshaping nests when they utilize old nests of hawks or squirrels, but in the present case no attempt at nest-building was evident. The eggs were laid in a very shallow oval depression (about 10" x 6"), apparently a natural irregularity in the ground surface, and the sparse nest-lining consisted only of lawn clippings that were at the site and still-rooted grasses matted down during the course of incubation.

**Nest Chronology:** In his five previous winter seasons as a lookout, Johnston had often seen and heard Barred Owls around Seven-Mile Fire Tower. During November and December 1956, two owls consistently frequented the immediate area and were seen a number of times in full daylight, either perched on the framework of the tower or on the ground beneath it near the eventual nest site. About 6:00 p.m. on January 5, one held its position at the foot of the tower as Johnston walked by within a few feet, and it was still there later that evening. At 9:30 a.m. on January 6, the bird was seen to leave, and a check of the spot showed that one egg had been deposited.

The date of the first egg (probably January 5) indicates a rather early nesting, the earliest date in 22 Florida records summarized by Bent (1938: 197) being January 11. Howell (1932: 295), however, recorded Barred Owl egg dates in Florida as early as December 23. The course of events at the nest after January 6 was as follows—January 7, second egg laid; seen in the evening, only one present earlier in the day. January 10, third egg suspected at 9:00 a.m., but the full clutch of three not seen until the nest was vacated briefly after dark on January 14. February 7, three eggs still unhatched at dusk. February 8, one egg shell seen beside the bird on the nest at 7:30 a.m., the first indication of hatching. Morning of February 9, another egg shell visible beside the sitting bird. (In both instances, the shells disappeared shortly, but the method of disposing of them was not

observed.) February 12, third nestling believed hatched, but not seen until February 14. February 15, two of the nestlings found dead at 7:00 a.m., one in the nest and one about six inches away from it. (They were removed and preserved as alcoholic specimens in the Everglades National Park collection.) The surviving member was smaller than the others and was believed to be the latest one hatched. It appeared vigorous and was being fed when last seen at 9:00 a.m. February 16, two Barred Owls heard calling repeatedly at 5:30 a.m. The nest was checked and found to be empty.

It is probable that the first two nestlings died of exposure, while the third may have been taken by a predator. The nearest weather station, 40-Mile Bend, Dade County, recorded a minimum temperature of 46°F on the night of February 14-15. This temperature in combination with high humidity and heavy dewfall may have been enough to chill the nestlings. Certainly the ground nest afforded them less protection than is usual in nests of the species. Johnston again observed both adult birds near the tower on February 17 and many later dates.

*Attentive Behavior:* In the period January 6-9 when the nest contained one or two eggs, it frequently was unattended. Johnston believed that the adult was away from the nest for one-third to one-half of the time during daylight hours. No regular pattern of daytime attentive behavior was apparent at this time, but the eggs were incubated at night. A marked increase in daytime attentiveness was noted on January 10, presumably with the addition of the third egg to the clutch. For the remainder of the incubation period, the nest was attended almost continuously, except for regular brief periods in the late afternoon or early evening. The incubating bird sometimes left the nest as early as 5:00 p.m. and as late as well after dark, about 7:30 p.m., but most of the departures occurred shortly before 6:00 p.m. The evening absences were brief, usually 15 minutes or less, and none was observed to exceed 30 minutes. On several occasions, the adult also left the nest in mid-morning. These morning inattentive periods occurred irregularly and tended to be of longer duration (9:00 a.m. to at least 9:45 a.m. on January 24). With the completion of hatching, attendance at the nest became even more constant. In close observation on February 14 and 15, the adult was seen to leave only three times (just before dawn on the 14th, and at 6:45 a.m. and 4:50 p.m. on the 15th), and none of the absences exceeded 10 minutes.

It is not known definitely whether nest duties were shared, because the opportunity to mark the adults for individual recognition was missed. In several days of nearly continuous observation by Truslow, the same individual was on the nest from early morning until dusk. The second adult occasionally appeared near the nest during the incubation period as late as February 9, but it was never observed to relieve the incubating bird. The possibility of a night shift - day shift division of labor cannot be altogether excluded, but the fact that the nest often was left unattended for brief periods suggests that only one member of the pair (presumably the female) was involved in incubation. Kendeigh (1952: 215) reported that incubation and brooding in all species of owls are taken care of chiefly by the female, although the male may assume some part in these activities.

The behavior of the present individuals served to extend the Barred Owl's reputation as one of the tamest of raptorial birds. In the first few days, the incubating bird responded to too close an approach by opening its beak, calling softly, and pecking toward the intruder. The common *Strigiform* threat-alarm behavior of beak-snapping was employed only once or twice. Later, all of these

responses were inhibited, and the bird on the nest appeared undisturbed by traffic passing within a few feet, except that it customarily swivelled its head to follow movements nearby. On January 30, Johnston lifted the incubating adult from the nest with a short section of fishing rod without eliciting any sign of annoyance. On February 3, I noted that the second adult spent the entire morning and early afternoon perched within the dense foliage of a small guava tree about 35 yards from the nest. When branches were pulled aside so that it could be photographed, the bird showed no response beyond narrowing its eyes against the unaccustomed light.

**Incubation:** Bendire (1892) assigned the Barred Owl an incubation period of three or four weeks, and Bent's (1938: 186) statement, "The incubation period is said to be between 21 and 28 days," apparently was taken from Bendire. More recent ornithological literature appears to contain no additional information on this point, but Mrs. Nice (1954: 175, 176) has noted that early authors consistently attributed too short incubation periods to owls, the Barred Owl on occasion having been credited with an incubation period of 17 to 18 days. The periods from laying to hatching for the three eggs in the present nest were: January 5 or 6 to February 7 or 8; January 7 to February 8 or 9; and, January 10 (probable) to February 12 to 14. Thus, the eggs were in the nest for 33 or 34 days, 32 or 33 days, and 33 to 35 days—the most likely period in each case being about 33 days. The central tendency shown by these data and also the fact that hatching extended over several days indicate that effective incubation began with the first egg. It was apparent, however, that incubation became more constant when the clutch was completed. Truslow watched the nest for a total of ten daylight hours on January 6 and 8, and observed that the eggs were not under incubation during this time. Instead, the adult sat at the edge of the nest with wings slightly opened apparently shading the eggs, and shifted position a number of times during the day keeping the eggs in its shadow.

**Feeding Habits:** The incubating bird apparently was not fed at the nest by the other member of the pair. No food was observed at the nest site until the morning of February 8, its appearance coincident with the hatching of the first egg. The only food items noted were small rats. From Johnston's description, I judge that these almost certainly were Cotton Rats (*Sigmodon hispidus*), a superabundant rodent that is the dietary staple of many Florida raptors. Holt and Sutton (1926: 430) noted that Barred Owls in the Cape Sable area of southern Florida subsisted largely on Cotton Rats.

From February 8 through 15, one to several fresh or partly eaten rats were usually in evidence beside the nest. No deliveries of food to the nest were witnessed, and most of these, as well as some of the feeding of the young, must have taken place after dark. Johnston first saw one nestling being fed at 7:15 a.m., February 10, and he and Truslow observed the process several times on subsequent days as late as the 15th. As an unvarying feeding routine, the adult held the rat against the ground with one foot and in leisurely fashion proceeded to dismember it with the beak. Rougher portions, such as the legs and tail, were eaten by the adult, while the owlets were fed small scraps of muscle tissue snipped from the rat's body and flanks and placed carefully in the nestling's open beak.

**Discussion:** Examination of Bent's "Life History" and the indices to literature published since 1936 discloses no reference to Barred Owl nests located otherwise than in natural tree cavities or the abandoned (usually) nests of hawks, crows, or squirrels. The closest approach to ground nesting is found in the few recorded

observations of nests located in stumps. Notably, the three examples to come to my attention all relate to Barred Owls in Florida. Bent (1938: 198) mentions a nest in the Kissimmee Prairie region "in an open cavity on the top of an oak stub only 6 feet high, in a dense hammock of large live oaks." The other two nests of this sort were found by Roy C. Hallman in a cypress swamp in St. Johns County from which the larger trees had been cut: one, March 25, 1934, in a hollow cypress stump three feet high, and one, March 4, 1936, in a similar four-foot stump. The single egg in each of the nests rested on dead cypress needles and rotten wood near ground level. The two nest locations were approximately 40 feet apart and, in all probability, the nests belonged to the same pair. Bent (1938: 184) has recorded other instances of the persistent attachment of Barred Owls to particular patches of woods in the face of disturbance by lumbering. I am much indebted to Mr. Hallman for permitting me to mention these records and to examine photographs of a parent bird at the first nest taken by Samuel A. Grimes. Two of the photographs have been published (Bird-Lore, 36: facing p. 283, 1934; Florida Nat., 10: 64, 1937); the first bears a brief explanatory legend, the other has no description of the circumstances involved. These stump nests, being located in natural cavities and within forest habitats, do not provide a close parallel to the ground nest here reported. They may, however, suggest that the Barred Owl in its Florida range is more prone to utilize unusually low nesting sites.

Individuals that depart markedly from the norm in choice of a nest site are of interest, because each such episode holds the potential of increasing the ecological amplitude and geographical range of the species, should it succeed and become established in part of the population. In the present instance, the source of the pioneering impulse is obscure, because typical Barred Owl nest sites are available nearby. The sawgrass marsh that predominates around Seven-Mile Fire Tower, encloses many island stands of mixed subtropical hardwood forest where natural cavities are present, if not plentiful, and both the Red-shouldered Hawk (*Buteo lineatus*) and Common Crow (*Corvus brachyrhynchos*) nest regularly in the immediate vicinity.

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**A New Breeding Record of the Wandering Tattler in Alaska.**—Although the Wandering Tattler (*Heteroscelus incanum*) has been known for years as a migrant along the Pacific Coast of North America, its breeding place remained undiscovered until 1912, when a nest was found 25 miles south of the Arctic Ocean west of the Alaska-Canada border. Since that time, only a few other nests have been found, all in Mount McKinley National Park, central Alaska (Dixon, Condor 35: 173-179, 1933; Murie, Condor 48 (6): 258-259, 1946). At this primitive stage of research into the breeding biology of the Tattler, it is felt that a series of





Wandering Tattler (*Heteroscelus incanum*). (Above) Nesting habitat at Eagle Creek, northeast of Fairbanks, Alaska. (Below) Nest site located among old tailing-piles. Nest occupied in June, 1957 and 1958. (Photos. by R. B. Weeden).

records obtained from Eagle Creek, Alaska, should be brought to the attention of interested ornithologists.

It is largely through the efforts of Mrs. Alice Hering, of Fairbanks, Alaska, that this information is available. Mrs. Hering is keenly interested in the natural history of tundra animals and plants in the Eagle Creek area, and made accurate and valuable observations on the Wandering Tattlers in 1957 and 1958.

Eagle Creek (65°30'N, 145°30'W) drains approximately 25 square miles of upland tundra above the junction of Ptarmigan Creek at mile 102 on the Steese Highway, northeast of Fairbanks. The region around Eagle Creek is one of moderately high, rounded hills (Tanana Hills) rising to 4000 or 5000 feet in elevation, about 3500 feet above the Yukon Valley to the north and the Tanana Valley to the southwest. All of the area above 3000 feet is covered by tundra vegetation, characterized by a lack of trees, few annuals, and many graminoids, bryoids, perennial forbs, and low shrubs. Creek bottoms and slopes below 2800 feet contain stands of white spruce (*Picea glauca*), aspen (*Populus tremuloides* and *P. balsamifera*), and birch (*Betula papyrifera*). Between the forest and the true tundra there is a zone of riparian shrubs along the banks of the streams. The upper reaches of Eagle Creek have been the site of sporadic placer gold-mining operations for many years; as a result, stands of tall willows (*Salix* spp.) which once lined its banks have been stripped away in many places, exposing large areas of coarse gravel (Plate 8, *Above*). Whether denudation has affected the welfare of the Tattlers is unknown. However, the pair (or pairs) in this area used old tailing-piles for nesting and for observation points during the breeding season.

In 1956 the Wandering Tattlers were seen first on May 27. No special effort was made to study the Tattlers at that time, because of work in progress on ptarmigan ecology. However, it was clear that the Tattlers were defending a territory and/or nest site during the latter part of June. On July 1 the pair was flushed from their habitual spot on the gravel bars of the creek bed, and a very young, dark gray, downy chick was found. The chick had hatched only a day or two before. Perhaps other chicks were in the vicinity, but none were seen. The Tattlers were observed until the end of July, when they probably moved out of the area.

In 1957 the writer visited Eagle Creek early in June; a pair of Tattlers was seen in the same place as in the previous year, but no nest was found. However, Mrs. Hering found the nest with four newly-hatched young in it on June 22. A photograph of the chicks was taken and sent to the writer for verification of the birds' identity. The young Tattlers left the nest immediately, and were not noted again that year, although the adults (and, presumably, the young) were present for several weeks thereafter.

The following summer Mrs. Hering visited the territory on June 20, and found one egg in the same nest that had been used in 1957 (Plate 8, *below*). The egg (44.9 × 30.8 mm.) was pipped, but the young Tattler had died before it hatched. Two egg membranes were found within a few feet of the nest. The adults were present close to the nest site on July 11, 1958, when the writer arrived at Eagle Creek. No Tattlers were observed after July 24.

It is probable that at least one member of the pair in 1958 was the same as in 1957, as the same nest was utilized both years. The same area was inhabited in 1956, and it is possible that the continuity of use for all three years was due to the presence of one or both birds every year. No other Tattlers were seen on the 25

square mile drainage in 1956, 1957, or 1958, although several miles of gravelly streambanks are present in the upper Eagle Creek area. Apparently the survival and return of young Tattlers to the area was not sufficient to increase the population during that three-year period.—ROBERT B. WEEDEN, *Department of Zoology, University of British Columbia, Vancouver 8, Canada.*

**Land Snails as Food of White-crowned Pigeon.**—At Krause Lagoon, St. Croix, Virgin Islands, several hundred White-crowned Pigeons (*Columba leucocephala*) nest yearly in the mangrove islands of this salt water marsh—the last remaining colony in these islands. For the past five years I have been banding these pigeons in an effort to determine the territorial range covered in their annual movement through the Virgin Islands. For this work squabs only have been used since the capture of adult pigeons in sufficient numbers for banding would be next to impossible.

White-crowned Pigeon squabs, always two in number—barring accidents—develop at an amazing rate. At twelve days of age they have become difficult to capture and when they are fifteen days old they can fly and may no longer be a banding possibility.

Undoubtedly one of the principal factors contributing to their rapid growth is the great amount of food fed to them by the parents. A White-crowned Pigeon colony at breeding time is a most active place. From dawn to dark the parent pigeons are on the wing in a constant effort to keep their demanding young filled. The foods given consist primarily of wild berries and fleshy drupes. The full crop of a pigeon squab is often larger and heavier than the rest of the bird. The early days of such squabs consist entirely of sleep and digestion.

The exception to the standard White-crowned Pigeon baby formula is the one where an engorged squab is picked up for banding and it is found that its weight in the hand does not somehow agree with the size of the bird. Examination of the squab discloses a crop full of rattling land snails—including shells! A disgorged snail proved to be *Drymaeus elongatus*, a common tree snail of the local scrub forest. These snails, generally a drab white, and measuring on an average  $25 \times 10$  mm., are quite abundant. They aestivate during dry periods and often appear like fruit clinging to the scrub. It was found that from one percent to two percent of pigeon squabs were fed these snails. I was told by my local guide that this occurrence was more apt to take place in years of extreme drought when other foods were scarce. Snail appearance in the pigeon diet may be dictated chiefly by necessity rather than by choice.—G. A. SEAMAN, *Box 474, Christiansted, St. Croix, Virgin Islands.*

**Notes on Bachman's Sparrow in Central Louisiana.**—Notes on the ecology of Bachman's Sparrow (*Aimophila aestivalis*) were obtained during a study of birds in relation to the direct or artificial seeding of Longleaf Pine (*Pinus palustris*) and Loblolly Pine (*P. taeda*) in central Louisiana from 1955 to 1957. Stoddard (in Burleigh, "Georgia Birds," pp. 667-668, 1958) has presented an account of the ecology of this species in the pine woods of southern Georgia. Detailed studies in Louisiana have not been reported. Observations were made on experimental lands of the Kisatchie National Forest, about 25 miles southwest of Alexandria, Rapides Parish.

**Habitat:** The terrain in this area varies from flat to gently undulating. Natural vegetation is predominantly Longleaf Pine with an interspersing of small stands





(Above) Nesting habitat of Bachman's Sparrow in central Louisiana. Note 3-year-old direct-seeded Longleaf Pine seedlings in foreground.

(Below) Whooping Crane (*Grus americana*) south of Hull, Illinois, October 23, 1958. (Photo, courtesy Ill. State Mus.)

of hardwoods along drainage systems. Some of the poorly managed and denser stands of pine have a shrub stratum of Sumac (*Rhus copallina*), Waxmyrtle (*Myrica cerifera*), Chinquapin (*Castanea pumila*), and patches of Blackjack Oak (*Quercus marilandica*) and Post Oak (*Q. stellata*) and scattered Black Gums (*Nyssa sylvatica*). Such scrubby growth is also characteristic of some sections of cut-over lands. In much of the open park-like stands of pine the shrubs are replaced by grasslands consisting mostly of bluestems (*Andropogon divergens* and *A. tener*) and forbs.

Forest management studies in progress in this area indicate that manipulation of the habitat greatly favors Bachman's Sparrow. The cycle of clear or partial cutting followed by direct seeding or planting provides, apparently, optimum habitat. A scattering of seed pine trees, clumps of shrubs and brush piles are left from these operations; these provide singing perches, escape cover and appropriate sites for nesting. The opening of the forest and burning of the ground cover results in an abundance and variety of foods, especially grasses and legumes associated with early stages of succession. Selective cutting or thinning of over-crowded stands produces an open park-like aspect approximating the optimum habitat of Bachman's Sparrow (Plate 9, Above). The Bobwhite (*Colinus virginianus*) and Eastern Meadowlark (*Sturnella magna*) are also favorably affected by such modern forestry operations.

**Food:** Bachman's Sparrow does virtually all of its feeding on the ground. Four out of five specimens collected during the winter of 1954-1955 and examined for stomach contents contained pine seed as a minor item. The major food was weed seeds (*Panicum* and *Sporobolus*) and beetles. During years of a bumper pine seed crop (about every fifth year) pine mast is available in great quantities from October to January. Artificial or direct seeding of Longleaf Pine in November and December and of Loblolly Pine in February and March supplements the native food supply. But in the artificial or direct seeding of cut-over lands Bachman's Sparrow is not an important depredating species. Damage to pine seed is inconsequential because of the relatively small numbers of this sparrow (one pair per two acres in optimum nesting habitat), non-flocking habits, and absence from large open grasslands.

**Nesting:** On warm sunny days of mid-February when temperatures reach 75 degrees Fahrenheit or more Bachman's Sparrow begins its song period. The onset of song at Alexandria, Louisiana in 1956 and 1957 preceded nesting by about two months. The usual song perch is a low pine bough, dead branch of a scrub oak, top of a brush pile or a pine stump, and usually from five to ten feet from the ground. Occasionally a bird sings from the ground. One bird was observed to sing 52 songs from the same perch in 15 minutes.

Evidence of the beginning of nesting was obtained on April 16, 1956 when a female (the male was singing 15 feet from the nest site) was seen carrying nesting material to the base of a Milkweed (*Asclepias* sp.) plant. The nest, constructed of Panic (*Panicum* sp.) and blue grasses, was virtually complete by this date and the first egg was laid April 17. An additional egg was deposited each day through the 20th, completing the clutch of four eggs. The four eggs were marked and on May 2, the first three eggs laid had hatched; the fourth egg laid hatched the next day.

On May 6, between 3:30 and 4:30 p.m. the young were fed three times, twice by the female and once by the male. The parent remained at the nest for from five

to fifteen minutes following feeding. Grasshoppers (Acrididae) and Coleoptera larvae were among items fed to the young.

In the same area bob-tailed young were still being fed by parents during the first week of August.—BROOKE MEANLEY, Patuxent Research Refuge, Laurel, Maryland.

**Whooping Crane in the Mid-West.**—On October 18, 1958, we were informed by Mr. Charles Dunker, Jr., a farmer living in Pike County, Illinois, of the presence of a Whooping Crane (*Grus americana*) on a farm operated by him in the Mississippi River bottoms near the town of Hull. We made an airplane flight to the area to verify his identification. The bird was photographed from the air, and, as it paid little attention to the plane, we were able to get sufficiently close to see its bare, carmine crown.

We visited the area by car on October 19, and observed the crane for several hours. Mr. Dunker informed us that he first noticed the bird on October 16, and reported it to Mr. Arch Mehrhoff, manager of the Mark Twain National Wildlife Refuge, who saw the crane. Later it was observed by a number of biologists, including William C. Starrett and Richard R. Graber of the Illinois Natural History Survey; Milton Thompson and Paul Parmalee of the Illinois State Museum; and William Greene, Duane Norman, Marshall Stinnett, and Victor Blazevic of the U. S. Bureau of Sport Fisheries and Wildlife. (See Plate 9 Below.)

The Whooping Crane was an adult, as determined from the absence of rust spots in the white plumage and the bare, carmine crown. It spent a large part of each day resting on a mud flat which jutted into a narrow, shallow pond which was about one-half mile in length. When interested in feeding, the crane flew from its resting place to a harvested corn field at the upper end of the pond. It would feed upon waste corn in the field and then walk along the margin of the pond, apparently thrusting its bill into crayfish burrows. The crane completed such feeding excursions in from two to four hours, traversing the length of the pond to its customary resting place.

The bird remained at this same pond until November 5; it was last seen late in the afternoon some four miles to the south. An aerial reconnaissance of the Mississippi River valley above St. Louis on November 6, failed to disclose its whereabouts, and no further report was received of this bird in the Mississippi River basin. However, an adult Whooping Crane, observed by Dick Droll, U. S. Game Agent, at Eagle Lake, near Houston, Texas, on November 9 and 10, 1958, is believed by Claude F. Lard, refuge manager of the Aransas National Wildlife Refuge, to be the same individual which was last seen near Hull, Illinois, on November 5. A short time later this crane joined the other 31 Whooping Cranes which had been on the Aransas Refuge for several weeks.

It is also highly probable that this Whooping Crane, which appeared on October 16, near Hull, Illinois, is the same individual which was observed from October 12–15 in the northwestern corner of Missouri, near Bigelow. That crane was last seen on October 15, flying to the southeast, according to Mr. Richard Vaught of the Missouri Conservation Commission. Since the bird near Hull was observed a day later, and that town lies 250 miles in an east-southeast direction from Bigelow, Missouri, it is probable that the same bird was involved in both observations.

Another Whooping Crane, a juvenile, appeared in the mid-West on December 1, 1958. On that date Lyle J. Schoonover, refuge manager, observed it on the Mingo National Wildlife Refuge near Puxico, in southeastern Missouri. This bird had rust patches on its head and wings, and hence could not have been

the bird observed in northwestern Missouri or west-central Illinois. The juvenile crane was last seen on the Mingo Refuge on December 17. Although game biologists, refuge managers, and game agents were alerted in the lower Mississippi and Central flyways, this crane was still unreported a month later.

Thus at least two Whooping Cranes, one an adult and the other a juvenile, appeared in or near Illinois in the fall of 1958, after an absence of nearly 70 years. The most recent records of this crane in Illinois, according to Allen ('The Whooping Crane,' Research Rep. No. 3, Natl. Audubon Soc., 1952), were of a specimen taken in Champaign County on March 27, 1871, and two specimens taken in April of 1891 in Jo Davies County. In Missouri there are later records; the last cited by Allen (*loc. cit.*) were in 1913. Early records indicate that these cranes were not uncommon migrants in the Mississippi Valley in the early 1800's.

From the standpoint of orientation in migration it would be important to discover the factor or factors responsible for the displacement of two Whooping Cranes some five hundred miles to the east of their normal flight line through western Nebraska. Moreover, the adult crane in its probable flight from north-west Missouri to west-central Illinois moved in the opposite direction from that which would have returned it to its regular migration route. Nevertheless, this crane apparently became aware of its eastern displacement during its three week stay in Illinois, for it evidently migrated southwestward to Eagle Lake, Texas, and thence farther southwestward to the Aransas Refuge.—HARLOW B. MILLS AND FRANK C. BELLROSE, *Illinois Natural History Survey, Urbana, Illinois.*

**Mutual Tapping of the Red-headed Woodpecker.**—Tapping is a distinctive mode of communication common to a variety of woodpeckers. Excellent descriptions of tapping by various European woodpeckers have been published (Pynnönen, 1939; Sielmann, 1958; Blume, 1958). Mutual tapping has hitherto been described only of the Red-bellied Woodpecker (*Centurus carolinus*) (Kilham, 1958). Similar mutual tapping by the Red-headed Woodpecker (*Melanerpes erythrocephalus*) is here described of a single pair observed at the Archbold Biological Station, Lake Placid, Highlands County, Florida, during a stay from April 27 to May 3, 1958.

**Mutual tapping at dawn.**—I walked toward the roost hole of the male, which was 10 feet up in a short stub entirely in the open, at daybreak on May 1. The male Red-headed Woodpecker put his head out of his roost hole at 5:20 A.M. He remained within the entrance for the next 10 minutes, calling "queeark" every 2-4 seconds with exception of a few longer pauses. The female flew by my head at 5:30 A.M. Her mate stopped calling as soon as he saw her approaching, dropped from sight into his hole and was tapping inside by the time she had arrived at the entrance. The pair now joined in mutual tapping. She gave one burst of 5 taps, then moved a few inches along the outside and tapped as before. The male continued tapping in a rather exhaustive fashion for several minutes, still hidden within the hole, while his mate calmly preened herself at the top of the stub. I witnessed this ceremony on 3 consecutive mornings. On the morning of May 2 the male called "queeark" 47 times in 5 minutes before his mate arrived. An interesting aspect of this ceremony at daybreak was that I had witnessed an almost identical pattern of behavior among pairs of Red-bellied Woodpeckers, as described elsewhere (Kilham, 1958). Both species tap at the same countable rate of 2 to 3 taps per second, usually in bursts of 5 to 15 taps each. The vocalization "queeark" of the Red-headed Woodpecker is, I believe, equivalent to the "kwirr" of the Red-bellied Woodpecker, these vocalizations for either species representing the breeding call of the male.

In continuing observations I noticed that the pair of Red-headed Woodpeckers might return every 15 to 30 minutes for more mutual tapping at the male's roost hole during the several hours after dawn. On May 1, for example, the male was on a pine tree when he called "queeak" 6 times, flew to his hole 30 yards away, popped inside and began tapping. His mate arrived a moment later. She tapped 5 times, then perched quietly while he continued to tap out of sight. The initiative of the male, evident in such episodes, was further apparent in the excavation of a new nest hole.

*Mutual tapping and the selection of a nest site.*—In spite of their tapping at dawn, the pair of Red-headed Woodpeckers did not appear to be satisfied with the male's roost as a nesting site. The hole was obviously old. I was not surprised to find the male starting a fresh excavation on April 28, at a spot 20 feet up in a dead pine. He spent much time working here for several days. I was watching on April 30 when he and his mate flew to the excavation from a distance. He tapped as they alit, but she did not join. Events which occurred later on the same day suggested that her lack of enthusiasm may have prompted him to try another site. Thus by afternoon he had started a new excavation higher up and on the opposite side of the same dead pine. He was working here on the following morning. When he paused to call "queeak" 3 or 4 times, his mate responded immediately by flying to him. I heard scratchy "kree" noises as the male tapped alone. The female returned 5 minutes later and this time I heard mutual tapping, although she was screened from view by the trunk of the pine. Her interest, however, was now becoming apparent. She replaced him at the work of excavating and on the following day I had a full view of the pair tapping together at their new location.

*Conclusions.*—The mutual tapping described is of interest for several reasons. It apparently serves 1) to strengthen the pair bond, and 2) to inform the male as to whether his choice of an excavation site is acceptable to his mate. As mutual tapping, not described for other species of woodpecker, is common to *Melanerpes* and to *Centurus*, it suggests that these genera are closely related.

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*"Wing-twitching" and Insect Capture by the Starling.*—In June, 1958, I twice observed a peculiar "wing-flashing" motion used by foraging European Starlings (*Sturnus vulgaris*). Sutton (1946) has described wing movements by several species of birds which apparently are associated with feeding, although he expresses doubt as to the true function of the motion in the Mockingbird (*Mimus polyglottos*). Subsequently, several observers (Wampole, 1949; Brackbill, 1951) studied the Mockingbird's motion and they considered it to be used in feeding. Recently, Whitaker (1957) has reviewed the occurrence of this trait in species other than the Mockingbird, but she does not mention any "wing-flashing" motions reported to be used by the Starling. The observations below are presented to describe this behavior trait in the Starling, and to suggest the motivation of this motion and, possibly, of "wing-flashing" motions in general.

On 19 June, I was observing several Starlings foraging in some uncut grass in downtown Washington, D. C., when suddenly one bird gave a quick spread of the wings, and pecked into the grass immediately thereafter. I could see that the bird had captured something, I believe an insect, which it swallowed. During the following week I observed foraging Starlings carefully in an attempt to see this motion again; in order to note more carefully the details concerned with it. On the 27th on the White House Lawn, I again saw a bird twitch its wings. This time a lone foraging Starling was looking into the grass about its feet when it raised and spread its wings synchronously in one very rapid motion, which I believe to be identical to the first. This bird, too, immediately struck into the grass with its bill, but I was unable to tell positively whether or not an insect had actually been taken.

I am hesitant to call the Starlings' motion "wing-flashing" because this term has been used to describe the controversial behavior motion of the Mockingbird (Sutton, 1946; Bent, 1948: 308; Wampole, 1949; Brackbill, 1951), foraging behavior of several species (Whitaker, 1957), ritualized hostile behavior in North American forest thrushes (Dilger, 1956), and even courtship in a Cuban thush (Vaurie, 1957: 308-310). Therefore, in hopes of avoiding confusion rather than adding to it, the motions of the Starling described above are hereafter referred to as "wing-twitching."

The function of this behavior of the Starling appears to be the same as that commonly ascribed to the wing-flashing of the Mockingbird; that is, the wing throws a sudden shadow over the grass which causes insects to move slightly or to jump and thus betray their presence. However, wing-twitching is morphologically quite different from the wing-flashing of the Mockingbird, which is the only other example of this type of behavior which I have so far observed. The Mockingbird's wings are opened by "hitches" in a jerky series of motions, which are quite slow in comparison with the rapid twitch of the Starling's wings. Morphologically, wing-twitching seems to be distinct also from the known ritualized behavior motions of the Starling (see text and references in Kessel, 1957: 266-269; and Hailman, 1958). The motion does show some similarity to flight-intention movements of this species, although the latter include sleeking the feathers, crouching the body, and flicking the tail—elements which were not present in the wing-twitching motions observed. It is conceivable, though, that the evolutionary origin of wing-twitching is flight intention. If startled insects moved in response to flight intention, then birds which did not fly (but quickly struck at the prey instead) might be selected for, because of greater success in food capture. This motion could then be incorporated into the regular foraging behavior, loosing the other components of flight intention in the feeding context. Thus (over a long period of time), the two behavior movements would be selectively separated. This, of course, is conjecture.

If the Mockingbird's "wing-flashing" turns out to function in foraging, as wing-twitching apparently does in the Starling, then I believe these motions will have to be considered analogous rather than homologous because of the evident differences in morphology described above. It is conceivable that the use of wing motions by ground foraging birds to startle insects has been "invented" independently many times, and therefore any future comparisons between species will have to consider the morphology as well as the context of such motions. Although all the mimic thrushes may use truly homologous motions, it is doubtful if the motions of all the species mentioned by Whitaker (1957) can validly be compared without more information than is presently available.

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- JACK P. HAILMAN, 4401 Gladwyne Drive, Bethesda, Maryland.

**Apparent Homosexual Behavior between Brown-headed Cowbird and House Sparrow.**—While watching a large mixed flock of Brown-headed Cowbirds (*Molothrus ater*) and House Sparrows (*Passer domesticus*) on October 26, 1958, in the cattle pens near the Oklahoma State University campus, I noticed a very peculiar action in a male cowbird. This bird was on a woven-wire fence about ten feet from where I was sitting. The cowbird had its head bowed with lower mandible touching the breast feathers and wings slightly raised at the shoulder. A male sparrow, which was perched beside the cowbird, mounted the cowbird, grabbed the head feathers in its beak and tried to copulate. The cowbird maintained the same position and the sparrow mounted it twice more, then flew a few feet away and perched on the fence again. The cowbird then flew over and perched beside the same sparrow, again assuming the described posture. The cowbird waited for a short time, and when the sparrow did not mount, it nudged the sparrow with its beak. The sparrow moved about a foot away. The cowbird followed, again assuming the same position. The sparrow mounted and attempted to copulate, then perched beside the cowbird. The cowbird retained the crouched position. When the sparrow did not mount again, the cowbird nudged the sparrow, which mounted again and then flew a few feet away. When the cowbird noticed the sparrow was gone, it followed. This behavior continued for 5-8 minutes until something frightened the flock, causing it to rise into the air and drop to the ground a few feet away. I could not find the pair in the flock again.

It has been observed that fledglings begging for food (crouched position, with raised head and open bill) sometimes release sexual behavior, causing attempts at copulation by males with the fledgling (Rittinghaus, Vogelwelt, 77 (4): 116-118, 1956). The cowbird described above appeared to be in adult male plumage and at no time was it seen to raise its head and open its bill in a begging manner; therefore, I do not believe that begging could have been the releaser of this unusual behavior.—DAUDE N. GRIFFIN, Department of Zoology, Oklahoma State University, Stillwater, Oklahoma.

**Ed. Note:** The bowing posture described above strongly suggests the ordinary incomplete courtship display of the male cowbird. Bowing often occurs in autumn (Friedmann, "The Cowbirds," p. 165, 169-170, 1929), and may even be used as a threat display towards other species, according to Laskey (Wilson Bull., 62: 159, 1950). The resemblance to the posture of a receptive female may have released

copulatory behavior in the House Sparrow—as can at times even a lifeless mounted specimen. If the cowbird was an inexperienced immature in first winter dress (not distinguishable in the field from an adult), its acceptance of contact from a different species is not too surprising in a parasitic bird, which might well have been reared by House Sparrows, or some superficially similar passerines.

**Observations on Effects of Cold Weather on Nesting Common Egrets.**  
—Common Egrets (*Casmerodius albus egretta*) wintered in the Bird City sanctuary at Avery Island, Louisiana, during the winter of 1957-58 and appeared to be nesting in late January and early February. On February 12, 1958, it snowed at Avery Island for the first time in a number of years and southern Louisiana recorded the heaviest snowfall since 1899. The temperature dropped to 22°F the nights of February 12th and 13th (see Table 1) and the snow persisted throughout the 13th and into the 14th.

TABLE 1  
MAXIMUM AND MINIMUM TEMPERATURES—AVERY ISLAND, LA.  
FEBRUARY, 1958

Date	Maximum (F.)	Minimum (F.)
February 1-2	60	32
February 3	54	35
February 4	60	40
February 5	67	60
February 6	68	45
February 7	68	30
February 8-9	59	35
February 10	40	30
February 11	40	30
February 12	35	22
February 13	45	22
February 14	55	40
February 15-16	55	32
February 17	45	32
February 18	44	34
February 19	47	40
February 20	60	40
February 21	65	43
February 22-23	59	54
February 24	65	50
February 25	60	49
February 26	70	55
February 27	70	50
February 28	73	45

On February 15, the writer visited the Common Egret nesting area to determine the status of the nesting. The egrets seem to prefer the cypress trees near the center of the pond and two man-made nesting platforms (Platforms 1 and 2) in the immediate vicinity of the cypress trees. As nesting sites in the cypress trees and on Platforms 1 and 2 are occupied, later arrivals spread out on three platforms out in open water (Platforms 3, 4 and 5). On February 15, egrets were incubating on nests in the cypress trees and on Platforms 1 and 2. There were 9 nests with eggs on Platform 5 and 5 partially completed nests on Platform 3; however, no birds were in attendance on these platforms. Nest and egg counts were made

in all areas. Sparse foliage on the cypress trees and the design of the platforms permitted an exact nest count although, as noted below, exact egg counts were not possible in all nests in the cypress trees. Nests and eggs were counted as follows:

Location	No. nests with eggs	No. eggs per nest				Total eggs
		1	2	3	4	
Platform 1	32	2	3	20	7	96
Platform 2	22	1	3	10	8	69
Platform 5	9	3	3	1	2	20
Cypress Trees	11			11 est.		33 est.
	74					218

In addition to the above, six eggs were counted out of nests (in some instances several feet from a nest) caught in the brush covering the top of the platforms. There were two dead birds on Platform 5.

The nesting area was revisited at intervals of four to seven days during the balance of February and early March. Nest and egg counts on February 19 were as follows:

Location	No. nests with eggs	No. eggs per nest				Total eggs
		1	2	3	4	
Platform 1	31		2	22	7	98
Platform 2	17	1	1	9	6	54
Platform 5	0					0
Cypress Trees	11			5 est.		33 est.
	59					185

Although the counts on Platforms 1 and 2 on this visit showed only a slight reduction in nests and eggs, indications were that new eggs had been laid in some old nests and a few new starts had been made, offsetting a slightly larger loss than is indicated by the figures. Ten eggs were counted out of nests. On Platform 5, no nests contained eggs, the nine nests previously recorded having apparently been abandoned sometime prior to February 15 and the eggs subsequently destroyed. One nest had a piece of egg in it.

On the days following February 19, the weather warmed considerably, and on February 21 a number of egrets were seen engaged in nesting activity on Platforms 3 and 5.

Counts were not made on the visit of February 26; however, all nests were inspected and no young had hatched. There was little indication of additional loss or abandonment and considerable evidence of new nesting activity.

On March 4, young were found in thirteen nests on Platforms 1 and 2, having hatched following the visit of February 26. Young were seen in several nests in the cypress trees. Allowing an incubation period of 23 or 24 days (A. C. Bent, 1926. *Life Histories of North American Marsh Birds*, U.S. Natl. Mus. Bull. 135, p. 138), the eggs from which these young hatched were probably laid between February 2 and February 9.

On March 9, young were counted in 27 nests on Platforms 1 and 2. New nesting had continued, principally on Platform 5.

The nesting areas were not visited again after March 9; however, visual inspections from the bank of the pond indicated that the nesting population continued to increase throughout the summer.

These observations appear to indicate that sub-freezing weather is disrupting to nesting Common Egrets and may cause abandonment of the nests if nesting has not progressed sufficiently. However, Common Egret eggs can apparently survive periods of freezing temperatures if the parent birds remain in attendance.—EDWARD M. SIMMONS, Avery Island, Louisiana.

**Cory's Shearwater at Palm Beach, Florida.**—A Cory's Shearwater (*Puffinus diomedea borealis*) was found dead on the beach of Phipp's Ocean Park on November 14, 1958, by Mrs. Roberta Knight. The bird was not collected until that night by Mrs. Knight, Mr. and Mrs. Robert Cointepoix, and the writer. When it was first found, the specimen was in a fair state of preservation, according to Mrs. Knight; however when it was taken off the beach later, its condition was not satisfactory for a skin. The head and feet were placed in formaldehyde and deposited with the Smithsonian Institution, where Dr. Alexander Wetmore confirmed the identification.

The length of the bird in the flesh was 19¾ inches and the wing-span was 43½ inches. The tips of the primaries were devoid of feather barbs, and a few small pieces of asphalt were in the wing feathers.

This specimen appears to be the first record for Florida. The previous southernmost United States record given by the A.O.U. Check-list (1957) is from South Carolina.—H. P. LANGRIDGE, 1421 W. Lantana Ave., Lantana, Fla.

**Little Egret Banded in Spain Taken in Trinidad.**—On January 13, 1957, Mr. C. L. Williams collected a white heron in the Caroni Swamp, Trinidad, West Indies, which bore a band "H 7414 Aranzadi Museo, San Sebastian, España." Sr. J. A. Valverde advised (*in litt.*) that the bird had been banded as a nestling by Sr. Orbe y Ancona at Coto Doñana, Huelva, Spain, on July 24, 1956. Sr. Valverde first wrote that the banded nestling had been a Cattle Egret, *Bubulcus ibis*, but he advised later that further check indicated it was a Little Egret, *Egretta garzetta*. As the specimen had not been sent to Spain, it seemed desirable to remove any question by forwarding it (preserved as a mummy) to the American Museum of Natural History, where an adequate comparative series was available. Mr. Eugene Eisenmann confirms that the bird is *Egretta garzetta garzetta* in first winter dress, with the following measurements: wing (flat), 255 mm.; tarsus, 101 mm.; culmen, 86 mm. This appears to be only the second report of the species from the New World; the earlier record, also a recent one, is of a bird taken in Newfoundland, May 8, 1954 (A.O.U. Check-list: 49, 1957).

Trinidad is some 4000 miles across the Atlantic from the Spanish locality where this bird was banded less than six months prior to its collection. According to Guy Mountfort's "Wild Paradise," p. 102-103, 1958 (Houghton Mifflin Co.), in the spring of 1956 the Little Egret was the most numerous heron in the Coto Doñana, with about 3000 nesting pairs, the next most numerous breeding heron being the Cattle Egret. He also writes that by 1956, several thousand nestling herons had been banded in Spain and that most of the returns have been of Little Egrets; the previous most westerly record of a banded individual being from the Canary

Islands.—WILBUR G. DOWNS, *Trinidad Regional Virus Laboratory, P. O. Box 164, Port-of-Spain, Trinidad.*

***Bubo virginianus* in Surinam.**—In his revision of the South American Great Horned Owls (Auk, 75, 1958: 143–149), Traylor omits Surinam among the localities on the map and on the list of specimens. This species has, however, long been known from Surinam and I have previously mentioned its occurrence *sub nom.* *Bubo virginianus scotinus* (Auk, 67: 218–219, 1950; Ardea 42: 331, 1954; "List of the Birds of Surinam," p. 68, 1955).

The measurements of my four specimens from Surinam are:

Locality and date	Sex	Wing	Culmen	Collection
Nieuw Nickerie August 4, 1946	♀	360	45	Am. Mus. Nat. Hist.
East of Coronie December 20, 1948	♀	348	46	Am. Mus. Nat. Hist.
Nickerie August 22, 1954	♀	353	50	Leiden Museum
Leonsberg (Surinam-river) October 25, 1958	♀	350	47	Leiden Museum

These measurements point to the fact that *Bubo virginianus* in Surinam belongs to the race which Traylor calls *B. v. nacurutu* (Vieillot), *B. v. scotinus* Oberholser being regarded as a synonym. As I mentioned in my earlier papers, this owl is not rare in Surinam, but is apparently entirely confined to the coastal mangrove forests of *Avicennia nitida* where I collected all my specimens. I wish to thank Mr. Eugene Eisenmann and Dr. G. C. A. Junge for providing me with the measurements of the specimens in the collections in their respective institutions.—F. HAVER-SCHMIDT, *Paramaribo, Surinam.*

***Quiscalus lugubris* in Brazil.**—Swainson (1837. Anim. Menag., p. 299) gave as type locality to the Carib or Swainson's Grackle just "Brazil" without a restricted locality, and subsequently Berlepsch and Hartert (1902. Nov. Zool., 9: 32) substituted British Guiana for Brazil. No recent author who has studied the distribution of this species has included Brazil within its range (Hellmayr, 1937. Cat. Bd. Amer., Field Mus. Nat. Hist., Zool. Ser., 13, pt. 10: 82). In December of 1951 Mr. Moreira, then working as field collector for the Museu Nacional—Rio de Janeiro sent five skins of this interesting species to that Institution. They were collected in northern Brazil, near the mouth of the Amazon, in the Territory of Amapá, Macapá, at a place called Retiro Lago Grande, December 5 and 7, 1951. The series comprises three adult males, one immature male and one female. All specimens have the wing feathers in molt. The wing measurements of the adult males are: 111.9–113.5 mm. and of the female 109.4 mm. These birds, according to the measurements, belong to *Q. l. lugubris*, the continental subspecies known from the Guianas to northern Venezuela.—FERNANDO C. NOVAES, *Museu Paraense "Emilio Goeldi," Caixa Postal 399, Belém, Pará, Brasil.*

**The Serratus Muscles in Cuckoos, a Correction.**—The serratus muscle-complex in birds is composed of multiple fasciculi that arise from cervical vertebrae and from several ribs. The complex typically is divided into three main parts plus a dermal component. I misunderstood some of the relationships of this complex

when writing my first two papers on the wing muscles of birds: "On the locomotor anatomy of the Blue Coua, *Coua caerulea*" Auk 70, 1953: 49-83), and "The myology of the pectoral appendage of three genera of American cuckoos" (Misc. Publ. Univ. Mich. Mus. Zool. No. 85, 1954). Like many other students of avian myology I was misled by parts of Shufeldt's "Myology of the Raven." I would recommend strongly that the beginning student ignore Shufeldt's work until he is thoroughly familiar with the myology of his particular group of birds (see the pertinent discussion by Hudson and Lanzillotti, 1955. Amer. Midl. Nat., 53: 2).

*M. serratus anterior* arises by one or more fleshy slips from cervicodorsal ribs and/or true ribs. To the best of my knowledge, the aponeurosis of insertion in all birds passes upwards between the two heads of *M. subscapularis* to insert (almost invariably) on the ventral edge of the scapula. It is the incorrect description of this muscle in the two papers mentioned above that resulted in a confused interpretation of the entire complex. Anyone familiar with these muscles would recognize the error at once. Only five or six years have elapsed since these papers were published, and it may be that someone will actually read the muscle descriptions sometime. Consequently, I publish these corrections lest some student be misled by my work. In any event, any error should be corrected. Following are the correct descriptions of the three serratus muscles in the four genera of cuckoos concerned.

#### *M. serratus anterior*

*Coua caerulea*: This muscle is composed of a single fleshy slip that arises from the last cervicodorsal rib ventral to its uncinate process. About 3 mm. inferior to the scapula, the fleshy fibers give way to a broad aponeurosis which passes upward between the two heads of *M. subscapularis* to insert on the ventral edge of the scapula beginning about 5 mm. caudal to the posterior glenoid lip.

*Geococcyx californianus*: The muscle arises by tendinous and fleshy fibers for a distance of 7 mm. from the anterolateral surface of the last cervicodorsal rib inferior to its uncinate process. The insertion is like that described above.

*Crotophaga sulcirostris*: The muscle is a single, rectangular, fleshy fasciculus, arising from the last cervicodorsal rib inferior to its uncinate process. The thin, but dense, aponeurosis (4 mm. wide and 2 mm. long) inserts on the ventrolateral edge of the scapula, after having passed between the two heads of *M. subscapularis*.

*Coccyzus erythrophthalmus*: The origin, structure, and insertion are similar to those in *Crotophaga*.

#### *M. serratus posterior*

*Coua*: This muscle consists of two main fasciculi plus a dermal component. The two main parts of the complex arise respectively from the uncinate processes of the first and second true (dorsal) ribs. The slips fuse and insert by fleshy fibers on the posterior 6 mm. of the apex of the scapula and by a thin aponeurosis on the ventral edge of the scapula, extending anteriorly to the insertion of *M. serratus anterior*. The dermal component has been described accurately (1953: 58-59).

*Geococcyx*: The muscle is like that in *Coua* except that the anterior of the two fasciculi inserts primarily by an aponeurosis as described above. The dermal component has been described accurately (1954: 14).

*Crotophaga*: *M. serratus posterior* arises primarily by three fleshy fasciculi from the uncinate processes of the first three true ribs. The fasciculi fuse and insert by fleshy fibers on the apex of the scapula, but anteriorly give way to a thin aponeuro-

sis which inserts on the ventral edge of the scapula. The dermal component has been described accurately (1954: 15).

*Coccyzus*: The origin, structure, and insertion are similar to those in *Crotophaga*.

#### *M. serratus profundus*

*Coua*: This complex arises by fleshy fasciculi from the transverse processes of cervical vertebrae Nos. 11 and 12, from the last cervicodorsal rib dorsal to the uncinate process, and from the upper half of the first cervicodorsal rib. These several fasciculi insert on the medial surface of the scapula in most of its caudal half.

*Geococcyx*: The complex arises by fleshy fasciculi from the transverse processes of cervical vertebrae Nos. 10, 11, and 12 and from the last cervicodorsal rib at about the mid-length of the rib. These fasciculi insert on the medial surface of the scapula beginning 15 mm. caudal to the acromion tip and extending caudad nearly to the apex of the scapula.

*Crotophaga*: The complex arises from the transverse processes of cervical vertebrae Nos. 10, 11, and 12, from the last cervicodorsal rib dorsal to its uncinate process, and from the penultimate cervicodorsal rib near the angle of the rib. The area of insertion begins 11 mm. caudal to the tip of the acromion and extends to the apex of the scapula.

*Coccyzus*: The complex arises by two fasciculi from the transverse processes of cervical vertebrae Nos. 10 and 11 and by two broad slips (3 mm. and 4 mm. wide), one from the last cervicodorsal rib dorsal to its uncinate process, and one from the first true rib, also dorsal to its uncinate process. The area of insertion on the medial surface of the scapula begins about 10 mm. caudal to the acromion and extends to the apex of the scapula.—ANDREW J. BERGER, *University of Michigan Medical School, Ann Arbor, Michigan*.

**Two Recent Records of the Roseate Spoonbill on the Pacific slope and high Andes of Peru.**—On October 3, 1956, Mr. C. Jackson Selsor and the writer observed a group of six Roseate Spoonbills (*Ajaia ajaja*) in a coastal marsh at Punta de Bombón, 34.4 miles south of Mollendo, southwestern Peru, by road, and approximately 60 air miles north of the Chilean border. The spoonbills were feeding in the company of Chilean Flamingos (*Phoenicopterus chilensis*) and Black-faced Ibises (*Theristicus caudatus melanopsis*).

On October 5, we noted a single spoonbill near the shore of an alkaline lake at Lagunillas in the Andes of south-central Peru. Lagunillas is a station on the route of Ferrocarriles del Sur del Peru that connects Mollendo with Juliaca and Puno, and its altitude is given as 14,280 feet. We believe this to be an altitudinal record for the Roseate Spoonbill. Approximately 50 Chilean Flamingos and one James' Andean Flamingo (*Phoenicoparrus jamesi*) were observed in close proximity to the spoonbill.

Previous records of the spoonbill in and west of the Andes in Peru and Chile would indicate that the species occurs in these areas only as a casual. Lesson (Voy. Coquille, Zool., 1, (1), 1828: 267) recorded it between "Payta" and Colán, Piura, Peru; and Taczanowski (Proc. Zool. Soc. Lond., 1877: 746) lists a specimen at Santa Lucia, "Tumbez," Peru. Goodall, *et al.* (Las Aves de Chile, vol. 2: 108, 1951) describes the spoonbill's occurrence in Chile as very casual in the provinces of Valparaíso, Santiago and Colchagua.—KEN STOTT, JR., *Natural History Museum, Balboa Park, San Diego, California*.

# REVIEWS

**Distributional Check-list of the Birds of Mexico.**—Part 2. A. H. Miller, H. Friedmann, L. Griscom and R. T. Moore. 1957. Pac. Coast Avi., no. 33. 436 pp., 7 col. pls. Cooper Ornith. Soc., Berkeley, Calif. Price: paper \$6; cloth \$7. (Parts 1 and 2 bound together in cloth, \$9.) Treating Trogonidae through Fringillidae, Part 2 completes the first detailed check-list of Mexican birds, Part 1 of which appeared in 1950. To the three original author-compilers Alden H. Miller was added as editor-in-chief. Though the format of the two parts is the same, one recognizes improving touches in points of detail. Everyone interested in Middle American birds will find this work of value. The distribution of each listed species is given as a whole, including the range outside of Mexico, then the general range of each Mexican subspecies, followed by the names of the Mexican states from which specimens are known. Of major usefulness is putting on record data from the great Moore collection of 55,000 Mexican specimens. Also indicated are the institutions where other significant, or previously unreported, specimens are lodged. Subspecies considered but rejected are mentioned in footnotes—a most commendable practice. These footnotes often contain illuminating comments on taxonomic points, sometimes serving to modify the text treatment.

Responsibility for the accounts of particular families was placed on different members of the compiling group, whose names are indicated. The taxonomic treatment usually conforms with that of the A.O.U. Check-list (1957)—not surprising, as Miller and Friedmann were members of the A.O.U. Check-list Committee. There are, however, a number of divergences in taxonomy and nomenclature (both scientific and vernacular). For example, *Myiarchus tyrannulus* is considered not to include the Central American *M. brachyurus*. This treatment makes somewhat misleading the range given for the species *M. tyrannulus* ("southern Texas through Mexico and Central America to South America"), for if *brachyurus* is specifically distinct, then as a breeder *M. tyrannulus* is absent from Central America south of Guatemala. Indeed one may then wonder whether the other northern forms belong with *M. tyrannulus*, a South American bird. On the purely nomenclatural side, generic names ending in *-rhynchus* and *-rhamphus* are treated as masculine, thus following traditional usage and anticipating the recent ruling of the International Commission on Zoological Nomenclature. The compilers considered unnecessary and confusing, and therefore declined to follow, the A.O.U. Check-list decisions replacing *Contopus richardsonii* by *C. sordidulus* and transferring the name *Empidonax wrightii* to *E. griseus*. Is not the failure to accept the A.O.U. rulings (involving only the names of three North American species) likely to produce even more confusion?

The Mexican Check-list supplies an English and a Spanish name for each species. Though doubtless regarded as a minor aspect of this useful work, common names, because of their importance in popular ornithology, warrant discussion, for indifference has often characterized their selection in otherwise meticulously prepared distributional works (e.g., Hellmayr's "Catalogue of Birds of the Americas"). There is certainly no obligation to supply vernaculars in such works, but if authors elect to do so, should they not be judged by the same critical standards as apply to other aspects of their undertaking?

In regard to English names the Mexican Check-list announced a sound basic policy—to provide names applicable to each species as a whole, rather than to any particular Mexican subspecies. Names of neotropical species are not yet

standardized by long usage; they cannot be drawn perfunctorily from the great monographs of Hellmayr or Ridgway, for these authors followed the older practice of giving to each *subspecies* a different English name, which often contained no suggestion of conspecific relationship. Selection of English names for the many *polytypic species* having wide neotropical distribution should involve consideration both of usage in previous literature and of the species characteristics throughout the range. For Mexico this task had already been undertaken in Blake's widely-used "Birds of Mexico" (1953)—so far the only identification guide to the avifauna. While opinion may differ on some of Blake's selections, this reviewer knows (from having participated in their selection) the effort devoted to seeing that the names should not be misleading for the species as a whole. In the interest of uniform usage many other authors dealing with Middle American birds have adopted the same names. The compilers of the Mexican Check-list of course had the right to adopt their own nomenclature, but to the extent that they disregarded the desideratum of uniform usage some good reason should have been apparent. Most of the names adopted in Part 2 do agree with Blake's selections, but many of the divergences (except where conforming with the new names of the A.O.U. Check-list) seem haphazard. Why, for example, was Ridgway's name for *Centurus hypopolius*, Gray-breasted Woodpecker, emended into the less correct 'Gray-bellied'? All ornithologists now agree that *Ramphocaelus rufiventris* is not an antwren (Formicariidae). Yet the misleading Long-billed 'Antwren' is here perpetuated, though most recent authors since Sutton have used Long-billed Gnatwren. *Aechmolphus mexicanus*, called Pileated Flycatcher by Blake, Edwards and others, is here endowed with the new name 'Crested Wood Pewee', though its nesting habits suggest no close relationship with *Contopus*. The names applied to some tanagers are so infelicitous that one wonders whether more was done in many cases than to extend to the species whatever designation Hellmayr happened to use for the nominate subspecies. *Spindalis zena*, a polytypic species, is called 'Black-backed' *Spindalis* (a name applied by Hellmayr only to one Bahaman subspecies, the nominate race); a glance at specimens would have revealed that most races, including the Mexican, have the back mainly olive—not black. *Tanagra lauta* is here called 'Thick-billed' Euphonia, perfunctorily following an unfortunate oversight in Hellmayr's book, which a few pages later used that identical name for another sympatric bird, *T. lanirostris crassirostris*, to which the name belongs by prior and universal usage since Ridgway (1902). In the case of *T. musica* Hellmayr's name for the nominate race, Haitian Euphonia, was obviously too restrictive for a wide-ranging species, but instead of adopting Ridgway's appropriate Blue-hooded Euphonia (used by all other writers on Middle American birds), the Mexican Check-list translates the technical name into 'Musical' Euphonia, although the vocalizations of this species are notably insignificant and unmusical.

Spanish names presented a really difficult problem, for most Mexican birds had neither Spanish book names nor widely used vernaculars. Here my criticism is that little guidance seems to have been given to the Mexican zoologist burdened with the formidable, and apparently unfamiliar, task of inventing hundreds of new species names. Why was he not instructed to follow the usual—simple, and educationally and mnemonically helpful—system of adopting the same *group* name for members of a genus or allied genera (except where the species had a real popular name)? Instead, we have an unsystematic and confusing application of the same group names to members of different families, while closely allied species

of the same genus are given different (yet invented) group names. A few examples will suffice. In the parulid genus *Vermivora* some species (such as the Tennessee Warbler) are called 'Verdín'; while others (such as the Orange-crowned Warbler) have the generic name translated into 'Gusanero'—a name which is also applied here to several tanagers. In the tanager genus *Piranga* some are given the name 'Piranga', others 'Aguacatero', and others 'Cardenal'—a group name likewise used for the grosbeaks, *Rhodothraupis*, *Richmondia* and *Pyrrhuloxia*. The designation 'Verderón', the Old World Spanish name for the Greenfinch (*Chloris*), is here extended both to the greenlets *Hylophilus* in Vireonidae and to various *Oporornis* in Parulidae. Perhaps the pressure to finish the long-delayed Part 2, a task made difficult by illness of two of the original three co-authors, precluded the needed critical editing of this phase of the work.

The matter of vernacular nomenclature has been elaborated in the hope that future authors will give it greater consideration. There is no intention to minimize our obligation to the authors of the Mexican Check-list for a truly monumental work, which should long provide a sound basis for distributional and taxonomic studies in an area of increasing interest to both amateur and professional ornithologists.—E. EISENMANN.

**The Ring-necked Duck in the Northeast.**—Howard L. Mendall. 1958. University of Maine Bull., 60(16): 1-317. 40 fig., 24 tab. \$2.50. This well written, monographic work on the Ring-necked Duck is outstanding in two ways. It reports one of the most thorough and extensive studies of any species of North American waterfowl, and it records first-hand observations of the spectacular range expansion of this species. Its coverage is broad and basic, containing sections on habitat, distribution, migration, the reproductive cycle, post-breeding activities, and management. Each chapter has a brief but clear summary but much of the value of the book lies in observational details which cannot be included in summaries.

Because of the recent spread of the species, the section on distribution is particularly thorough. Expansion of the breeding range has been dominantly eastward and the bird is now well established in the northeastern states and eastern Canada. Much of the former habitat in the Midwest has been lost but isolated breeding populations occur sporadically. Despite Mendall's thorough survey of distribution data from state biologists, one record of a temporary breeding population was missed. Paul L. Errington (oral communication) found indications of nesting in north-central Iowa in the late 40s and early 50s and four nests were found on muskrat lodges during 1953. Drought apparently damaged this habitat and there are no more recent records for the species.

The chapters on nesting and the brood season constitute the greatest contribution of the book. Descriptions of display are accurate and vivid but are not analytical. A section on territoriality is detailed and emphasizes the point that spacing occurs without conspicuous aggressive action. Data from 471 nests are presented clearly and in a form usable by other waterfowl students. Island nest sites are clearly preferred but there is almost no use of emergent vegetation as in other diving ducks. Two interesting factors influencing the time of nesting were age of the female and habitat conditions; both need further study but these conclusions are supported by similar observations in other groups of birds. For the first time in diving ducks, factual and circumstantial evidence is presented which indicates that at least 50 per cent of the females re-nest if their initial nest

is destroyed. Observed nesting success was a relatively high 68 per cent. Habitat improvement and delay of the shooting season from September until October have proved effective management measures for protecting and increasing local breeding populations.

Much specific information, of less general interest but relevant to the text, is presented in appendixes. Thus under one cover is the major present knowledge of this species. Despite the comprehensive scope of the work, Mendall makes every effort to point out where data are weak or lacking and poses sufficient problems to keep waterfowl investigators busy for many years.—M. WELLER.

**A Distributional List of Chinese Birds.**—Tso-Hsin Cheng. A publication of the Institute of Zoology, Academia Sinica, Hsien, Peking (53), China. 1955. Pt. 1. Non-Passeriformes, pp. i-iii + 1-329; 86 distributional maps. 1958. Pt. 2. Passeriformes, pp. i-vi + 1-591; 441 distributional maps. This first official check-list of Chinese birds includes all forms recorded within the boundaries of China, including Tibet and Taiwan. The region covered is huge, rich, and very varied. 486 species are treated in Part 1 and 613 in Part 2; with subspecies the total reaches nearly 2000. The text is in Chinese as far as the ranges are concerned, and, while this reduces its usefulness for the western reader, the work is designed primarily for Chinese students "in the hope that it may serve as a working basis for further investigations in Chinese ornithology." This quotation is from the only two brief pages in English, one in each part.

Despite the language difficulty, this list is extremely useful. Though the ranges are stated in Chinese, apparently in very brief terms, the numerous distributional maps are readily understandable. This list is superior in some respects to the current check-lists from many countries, for in addition to the more than 500 maps, references and complete synonymies are given for all birds described from China. Detailed bibliographies are included. For instance, nearly 700 titles are listed in Part 2, and virtually all are modern papers; only about 30 were published before 1920, and some published as late as January, 1958 are included. All references in the synonymies and bibliographies are cited in the original languages and alphabet. Finally, vernacular names are given in Part 2 for each species in Chinese, English, and Russian (in Part 1 only in Chinese), and there are indexes of scientific, English and Russian names. Lest these remarks concerning bibliographical matters give the impression that this work is only a compilation, let me add that Dr. Cheng has, to my knowledge, studied the collections in Berlin, Leningrad, and Moscow, and spent three years in the United States, chiefly at the American Museum of Natural History. The nomenclature and taxonomy is modern. The systematic sequence follows the general lines of Wetmore's classification. Dr. Cheng and the Academia Sinica deserve congratulations.—CHARLES VAURIE.

**A Hand-list of the Japanese Birds.**—Ornithological Society of Japan, Yamashina Institute for Ornithology and Zoology, 49 Nanpeidai-machi, Shibuya-Ku, Tokyo, Japan. March, 1958, pp. 1-264 + 10. Price 500 yens. This is the "Fourth and Revised Edition" of the Japanese official check-list, the "area [covered being] restricted to the present Japanese domain." This statement reflects a curtailment of the area covered by previous editions. The Kuriles, Sakhalin, Korea, some islands in the Sea of Japan, the Ryu Kyus, Formosa, the Borodinos, Bonins, Volcanos, Marianas, Palaus, Carolines, Marshalls, and Wake have been excluded. This has halved the number of species and subspecies, from 1087 in the third

edition to 552 in the present one. The drastically reduced scope of the present edition is somewhat compensated by two novelties: a statement of the world distribution of the species, and a very valuable indication of the biological status of the form concerned. The List Committee states that they prefer not to change the systematic sequence adopted in the third edition (1942), which followed Hartert.—CHARLES VAURIE.

**Aves del Sahara Español.**—José A. Valverde. 1957. Instituto de Estudios Africanos, Consejo Superior de Investigaciones Científicas, Madrid. pp. 1-488 + 12; figs. 0 and 1-120; pls. 1-51. Price, 300 pesetas. This is a remarkable study of the ecology of the Spanish Sahara desert. The author, who knows his region intimately, starts by discussing its regions and the biotopes they offer. The climate is very severe and ecological conditions seldom remain stable. A list of the species follows with much detail on behavior, habitat, food, reproductive cycle, local movements and migration. The distribution of each species is given in detail and is often plotted on maps. These and the other line drawings by the author, which consist of schemas of the habitat, sketches of animals, or of some aspects of their behavior, such as nuptial flight, are excellent. The photographic plates are no less interesting, but, unfortunately, did not reproduce well on the paper used. It is difficult to overpraise this study, which will be of fundamental importance in the study of desert faunas. A gazetteer, bibliography, a list of Moorish names, and even some local legends, are supplied in several appendices. Incidentally, the title is misleading as the study is not restricted to birds, but includes mammals, reptiles and frogs. (In Spanish.)—CHARLES VAURIE.

**[Ecology of the Colonial Sea Birds of the Barents Sea.]**—L. O. Belopolski. 1957. 460 pp.; 16 pls.; 135 text figs. Academy of Sciences of the U.S.S.R., Moscow, U.S.S.R. Price 22 roubles. (Procurable Am-Rus Literary and Music Agency, 24 W. 45 St., New York 36, N. Y.) This well-illustrated book discusses the ecology in northern Russia of eighteen, mostly Holarctic birds: Fulmar, Great Cormorant, Shag, Common Eider, Parasitic Jaeger, Kittiwake, Ivory Gull, Mew Gull, Great Black-backed Gull, Herring Gull, Glaucous Gull, Arctic Tern, Common Puffin, Dovekie, Black Guillemot, Thick-billed Murre, Common Murre, and Razorbill. Unfortunately, the scientific names are mentioned only in the preliminary pages on distribution and in the index. Arrival dates, nesting behavior, development of young, food, interspecific competition, are among the subjects treated, with many tables, graphs, diagrams, and photographs. Those working on Arctic and Sub-Arctic birds will find the book useful. (In Russian, no foreign language summaries.)—CHARLES VAURIE.

**The Birds.**—Oskar Heinroth and Katharina Heinroth. 1958. 179 pp., 89 figs. University of Michigan Press, Ann Arbor, Michigan, and Ambassador Books Ltd., Toronto, Canada. Price, \$5.00. This is a translation of Oskar Heinroth's classic work, "Aus dem Leben der Vögel," as revised by his widow. It is a lucid, short, popular account of bird biology, from the viewpoint of behavior and structural adaptation, with wide appeal. Written in an extremely simple style, the twenty-two chapters are full of fascinating and significant details, which the novice bird student can enjoy and from which the experienced ornithologist can draw profit.

The modernity of the present revision is indicated on both the first and last pages; the former refers to the hibernation of the Poorwill and torpidity in swifts and hummingbirds, and the last to the recent experiments indicating nocturnal

bird orientation by means of constellations. There are a great many nuggets of information that will be new to most ornithologists. A few examples follow: Although it is now generally accepted that full grown feathers do not change color by the deposition of new pigment, the authors say that the Cattle Egret may be an exception, for the buffy nuptial color appears after the white feathers are full grown, a brownish sediment forming, perhaps through the action of light. Though penguins' wings have become flippers, they sleep with the bill hooked behind the wing, like most flying birds. Wild birds rarely lay eggs unless the female has been stimulated by at least the presence of a male, but in captivity pigeons and parrots will sometimes produce infertile eggs when they have been fondled by a human keeper. The Heinroths emphasize the enormous diversity of bird behavior and try to avoid broad generalizations. The danger is apparent when they venture to say that "all pigeons" lay white eggs. Actually, the Ruddy Quail-Dove lays brownish eggs.

This little book does not purport to cover all aspects of avian biology; distribution, ecology and population dynamics are hardly mentioned. The Heinroths draw on their great and intimate experience with living birds. The German title is thus more suggestive of the subject matter. The illustrations in this edition are exceptionally effective, and the translation by Michael Cullen is idiomatic and easy reading.—E. EISENMANN.

**Das Jahr mit den Spechten.**—Heinz Sielmann. 1958. Verlag Ullstein. West Berlin, Germany. 152 pp., 61 photos., 4 in color. Sielmann's book, like his well known motion picture of woodpeckers, combines his skill as a photographer with an understanding of animal behavior, fostered by contact with Konrad Lorenz. "Das Jahr mit den Spechten" is an unusual study. For example, on finding the hole of a pair of Black Woodpeckers (*Dryocopus martius*) in a beech tree, Sielmann and associates chiseled five inches or more of wood from the rear of the nest cavity and inserted a pane of glass. His pictures, taken within one or two feet, show the parent woodpecker entering the hole, moving down head first, nudging the knob of a young one's bill to make it feed, then nudging it at the other end to obtain a fecal sack. The parent bird has head and tail pointing vertically upward when brooding within the narrow cavity. Some of the observations represent original contributions. In a nest relief ceremony, the bird on the eggs starts tapping on the inside wall as soon as it hears the call of its mate. This tapping is also a ceremony prominent in the excavation of the nest hole. Sielmann's book has good, but less complete nesting studies of the Great Spotted (*Dendrocopos major*) and Green (*Picus viridis*) Woodpeckers. Hand-raised individuals gave opportunities for close-up observations. The way the various woodpeckers use their remarkable tongues, locate grubs deep within hidden tunnels in logs, and break open nuts by use of an anvil are among the many aspects of the biology of these birds which the author has both photographed and described. His book is written for the general reader, but should be of interest to any student of bird behavior, and particularly to those with special interest in woodpeckers. The European woodpeckers described have much in common with American species of the same or of related genera.—LAWRENCE KILHAM.

RECENT LITERATURE  
EDITED BY FRANK MCKINNEY

ANATOMY

- AUBER, L. 1958. Magenta colour in feathers: a parallelism. *Ibis*, **100**: 571-581.—*Nyctyornis amicta* (Meropidae) and *Chlamydera maculata* (Ptilonorhynchidae) possess magenta colored feathers on the crown and nuchal crest, respectively. While most non-iridescent purple shades are due to modifications of the blue-producing Tyndall histological arrangements, which are underlain by an opaque substratum, this magenta depends on media underlying a transparent substratum. In both species, the color is of an "advertising nature"; magenta color in the two species is analagous, but not homologous in all details. In *Nyctyornis*, the magenta feathers suggest relationship with Coliidae and Alcedinidae. The author presents a detailed histological and cytological analysis including illustrations.—J. W. H.
- HUMPHREY, P. S. 1958. The trachea of the Hawaiian Goose. *Condor*, **60**: 303-307.—The first recorded account of this structure in this species is given and involves anatomical observations of the trachea, its muscles, bronchi, and syrinx. Comparisons of various structures (number of bronchial semi-rings, muscle origins) are made among several species of *Branta* and *Anser*.—D. W. J.
- SELANDER, R. K. 1958. Age determination and molt in the Boat-tailed Grackle. *Condor*, **60**: 355-376.—This detailed work concerns principally characteristics used in determination of age in *Cassidix mexicanus prosopidicola*. For juvenals, first-year, and adult birds of both sexes, data are given on pterylography, molts, cranial ossification, size, bill length, weight, and iris color. Some correlations are drawn among testis regression, molt, and weight loss.—D. W. J.
- SMITH, N. 1958. Leg color of the Blackpoll Warbler in fall. *Proc. Linnaean Soc. N. Y.*, Nos. 66-70: 90.—Of 10 Blackpolls killed by striking a building 3 had dark (instead of light) tarsi, but light toes.—E. E.
- VERHEYEN, R. 1958. A propos de la mue des remiges primaires. *Gerfaut*, **48** (2): 101-114.—Describes, with diagrams, the various methods of primary molt, and the groups, so far as studied, in which each method prevails. Most birds, including all passerines, molt regularly from the innermost primary outward; in limpkins, sungrebes and some rails, the opposite order of molt prevails; in the Anseriformes, flamingos, loons, grebes, jacanas and a few others there is simultaneous molt; in Falconidae and perhaps all parrots the molt starts with one of the middle feathers and proceeds in both directions. Rare methods involve beginning with the innermost and outermost and proceeding towards the middle, or preceeding alternately, or having the molt relationship between adjacent pairs of feathers. Molt system is a useful feature in taxonomy, but, as it may have adaptive functions, Verheyen points out that it cannot be used alone, e.g., *Anhinga*, despite close relationship with the cormorants, differs from all other Pelecaniformes in having simultaneous molt of primaries. (In French.)—E. E.
- VERHEYEN, R. 1958. Note sur l'absence de la cinquième rémige secondaire (diastataxie) dans certains groupes d'oiseaux récents et fossiles. *Gerfaut*, **48** (2): 157-166.—Orders are listed (with exceptional families or genera) in which the fifth secondary is present (eutaxy) or absent (diastataxy); though in some natural groups allied genera differ, and occasionally the same individual will have one wing diastataxic and the other eutaxic. (In French.)—E. E.

## BEHAVIOR

- BANCKE, P., and H. MEESBURG. 1958. A study of the display of the Ruff (*Philomachus pugnax* (L.)). II. Dansk Orn. Foren. Tidsskr., 52: 118-141.—Chiefly relates to the time spent on the display grounds by the dominant and other males, with some information on hierarchy, fighting, etc. (In English.)—E. E.
- BLACKFORD, J. L. 1958. Territoriality and breeding behavior of a population of Blue Grouse in Montana. Condor, 60: 145-158.—A detailed study based upon territoriality of three distinct males. Included in the paper are notations on wing notes, drumming, courtship, and other aspects of breeding behavior which generally elucidate relationships between the racial groups of *Dendragapus obscurus*.—D. W. J.
- DAVIS, J. 1958. Singing behavior and gonad cycle of the Rufous-sided Towhee. Condor, 60: 308-336.—This lengthy paper correlates events in the gonad cycle with singing behavior of birds in central California. The height of the male gonad cycle was in April, May, and June, whereas females were at a peak principally in May. Singing began at least by February and ended in early August. As nesting was underway in late April, singing was at a high level. Furthermore, the beginning of singing correlated with an initial increase in the number of Leydig cells in early February. A decrease in singing in late July correlated with onset of molt and gonadal regression.—D. W. J.
- GATES, J. M. 1958. Female Gadwall returns to nest site after loss of young. Condor, 60: 337-338.
- GOODWIN, D. 1958. The existence and causation of colour-preferences in the pairings of feral and domestic pigeons. Bull. Brit. Orn. Club, 78: 136-139.—Observations of 732 pairs of domestic and feral *Columba livia* indicated some mating preference for their own color type or those of their parents. This may be the result of the proximity of similarly colored relatives or imprinting on their parents.—E. E.
- GUTTMAN, N., and H. I. KALISH. 1958. Experiments in discrimination. Scientific American, 198: 77-82.—Pigeons trained to peck at a disk when exposed to light of a particular wavelength were later exposed to light of other wavelengths. It was found that the rate at which the pigeons pecked was directly proportional to the closeness of the experimental wavelength to the training wavelength. This relationship exists even when light of a number of colors other than the training color is used. Pigeons positively trained to one wavelength and negatively trained to another have their responses following training shifted beyond the wavelength to which they were positively trained in the direction away from the wavelength to which they were negatively trained.—J. C. H.
- PALUDAN, K. 1955. Some behaviour patterns of *Rissa tridactyla*. Vidensk. Medd. Dansk. Naturh. Foren., 117: 1-21.—A detailed study of various aspects of Kittiwake breeding behavior, compared with the Herring and Lesser Black-backed Gulls. (In English.)—E. E.
- PERDECK, A. C. 1958. Gedragstudie van de Grote Jager. In Jaarverslag van het Vogeltrekstation over 1957. Limosa, 31: 97-102.—Studies in the pairing and copulatory behavior of the Great Skua (*Catharacta skua*), illustrated by 11 drawings. (In Dutch; brief English summary.)—E. E.
- POULSEN, H. 1958. The calls of the Chaffinch (*Fringilla coelebs* L.) in Denmark. Dansk Orn. Foren. Tidsskr., 52: 89-105.—The various vocalizations are described and illustrated by sonograms, and their functions indicated. There are local

dialects not only in the song but in the *huit* alarm call. Chaffinches raised in isolation do not give the full song until they have heard other males and practised by counter-singing. A tape-recording played outside a male's territory will evoke counter-singing; if played inside its territory the male will approach and will attack a stuffed Chaffinch. Sexual stimuli may inhibit song: a captive male stops singing when seeing a female. (In English.)—E. E.

STOWELL, R. F. 1958. Notes on the behaviour in captivity of the African Fish Eagle *Cuncuma vocifer*. *Ibis*, 100: 457-459.

THORPE, W. H. 1958. The learning of song patterns by birds, with especial reference to the song of the Chaffinch *Fringilla coelebs*. *Ibis*, 100: 535-570.—An important paper reporting many facts which cannot be summarised here. The song of the Chaffinch is partly inherited, partly learned. It varies racially, and individuals may render up to six varieties of the song. Captivity did not inhibit the drive to sing, but the onset of song could be controlled by crowding, illumination, and injected testosterone propionate. If nestlings are isolated, they eventually give a very simple song—the inherited component of the specific song. If isolated nestlings are grouped together, they mutually stimulate each other to complex but specifically atypical song. Wild young thus learn some singing from their male parents, but develop details of singing in competition with other territory holders. Song-dialects are created and perpetuated by mutual stimulation, copying, and competition in a limited group of finches. Subsong is of low intensity but more complex than full song; it is characteristic of birds with low but increasing production of sex hormones. Chaffinches do not normally imitate other species, but captives may learn notes or phrases if these resemble parts of the Chaffinch song. A Chaffinch tends to reply to his neighbour's song with a similar one; the birds copy each other and show especially close resemblance in the last phrase of the song. When an individual has more than one song, each outburst consists of a sequence of one followed by a sequence of another. Learning of song takes place in the first 13 months, with a peak in the last few weeks of this time, during which variety is achieved by competition.—J. W. H.

TINBERGEN, N. 1957. Defense by color. *Scientific American*, 197: 48-54.—A popular account of the role of patterns of color in the survival of prey animals. Laboratory tests were made of the effectiveness of insect color patterns in reducing the likelihood that a bird would discover an insect. Protectively colored insects were overlooked a significant number of times. Laboratory experiments showed that spots resembling the eye spots of insect wings were effective in frightening birds. Behavior patterns of insects are such as to increase the survival value of their color patterns.—J. C. H.

WAGNER, H. O. 1958. Gemischte Vogelverbände in Mexico, insbesondere das Verhalten nordischer Zugvögel. *Zeitschrift für Tierpsychologie*, 15: 178-190.—This paper deals with the causation of winter flocking in birds which do not ordinarily form flocks. Sedentary species form the core of such flocks and the biological advantages of such behavior are discussed. (English summary).—W. C. D.

WEIDMANN, U. 1958. Verhaltensstudien an der Stockente (*Anas platyrhynchos* L.) II. Versuche zur Auslösung und Prägung der Nachfolge- und Anschlussreaktion. *Zeitschrift für Tierpsychologie*, 15: 277-300.—Critical experiments on the following and flocking responses of 50 Mallard ducklings are presented. The theoretical aspects of imprinting are helpfully discussed. The readiness to follow can be suppressed by other drives, especially the escape drive. Readiness to follow also

decreases with increasing age of the birds. It is suggested that the same basic response is involved in both following and flocking behavior. The upper limit of the sensitive period was found to be rather variable. The following of experienced ducklings differs somewhat from that of ducklings following for the first time. Experienced ducklings prefer the object hitherto followed and follow long after the sensitive period. They also react to less complete stimulus situations, are less likely to lose their "parent," respond more quickly, and search for a lost "parent." All of these changes appear within the first half hour of following. There is no evidence that imprinting can occur instantaneously. The "irreversibility" of imprinting was experimented with and discussed. Since imprinting is a type of learning the question of the possible reward is discussed. It is suggested that the act of following might be sufficient reward. (English summary.)—W. C. D.

WESTERSKOV, K. 1958. Zum sozialen Verhalten Jagdfasans (*Phasianus colchicus*). Orn. Mitteil., 10: 84.—In Europe and North America, where winters are snowy and cold, unisexual groups are the usual winter aggregation. In New Zealand, where autumn and winter are mild, three-quarters of all pheasants during these seasons were observed alone and only one-fifth in unisexual groups, which averaged 2-3 individuals. (In German.)—E. E.

WOUDSTRA, D. 1958. Waarnemingen bij nesten van Waterral (*Rallus aquaticus*) en Porceleinhoen (*Porzana porzana*). Limosa, 31: 28-31.—A Water Rail three times disturbed at the nest, when some concealing vegetation was cut for photography, removed the eggs to a new nest partly by rolling and partly by picking up the eggs with the bill. This process was repeated when the eggs were returned to the old nest. A Spotted Crane when disturbed from her nest always quickly returned, even while the author was touching the nest. (In Dutch; English summary.)—E. E.

#### DISEASES AND PARASITES

GRICE, G. D., JR., E. L. TYSON, AND E. B. CHAMBERLAIN, JR. 1956. An unexplained mortality of Canada geese in north Florida. Journ. Wildl. Mgt., 20: 330-331.—Reports sickness and death of a number of Canada geese in the vicinity of a 5-acre pond near Tallahassee, Florida, during February and March, 1954. Causes of the mortality were not uncovered. Tests for *Clostridium botulinum* were negative. A dinoflagellate (*Peridinium volzii*) bloom and fowl cholera were suggested as possible causes of the mortality.—R. F. L.

JENNINGS, A. R. AND E. J. L. SOULSBY. 1958. Disease in a colony of Black-headed Gulls *Larus ridibundus*. Ibis, 100: 305-312.—One fungus, *Aspergillus fumigatus*, a virus (not identified), and two parasitic worms, *Diplostomum spathaceum* and *Cryptocotyle lingua* were found to be prominent forms infesting the gullery. Heavy losses in nestlings seem to result from chilling; heavy parasitic burden is more than likely a contributing factor to deaths. The unidentified virus caused lesions on the webs of the feet. Possibly related viruses are discussed.—J. W. H.

VASILEV, I. D. 1958. [Analgesoidea mites—ectoparasites of birds of the Lake Srebreensk near the town of Silistra, Bulgaria.] Zoologicheskii Zhurnal, 37 (9): 1325-1339.—Mites of 20 bird species from 8 families are treated. (In Russian; English summary.)—E. E.

#### DISTRIBUTION AND ANNOTATED LISTS

ALDRICH, J. W., AND A. J. DUVALL. 1958. Distribution and migration of races of the Mourning Dove. Condor, 60: 108-128.—An extensive study which summarizes the

- current taxonomy and distribution of *Zenaidura macroura*. Geographic variation in measurements and color are discussed, and five subspecies are delimited: *marginella*, *macroura*, *carolinensis*, *turturilla*, and *clarionensis*. Ecological boundaries generally separate breeding races from one another, but there is extensive postbreeding wandering so that some races may mingle with others in migration.—D. W. J.
- BAILEY, A. M. 1958. Birds of Midway and Laysan Islands. Museum Pictorial, No. 12: 1-130, many photos, 1 col. pl. Denver Mus. Nat. Hist.—An account of the species known to occur. Three of the five endemics became extinct in the past thirty-five years.—E. E.
- BALLANCE, D. K. 1958. Summer observations on the birds of the Anatolian Plateau and northwestern Cilicia. *Ibis*, 100: 617-620.—Observations made in 1957 report species previously unknown in the area (according to Wadley and Hollom) and add more information on certain species mentioned by these authors. An itinerary and annotated specific list are provided.—J. W. H.
- BERGER, A. J. 1958. The Golden-winged-Blue-winged Warbler complex in Michigan and the Great Lakes area. *Jack-Pine Warbler*, 36: 37-73.—The local distribution is given in detail of *Vermivora chrysoptera*, *V. pinus*, and their hybrids. The Blue-winged Warbler has definitely been spreading northward into the range of the Golden-winged Warbler; and probably the latter has also been spreading north. In southeastern Michigan, the author found the largest concentrations in tamarack-poison sumac swamps, where both species "have invariably been found together." Elsewhere some observers report that the Blue-winged Warbler tends to favor drier, more brushy, areas than the Golden-wing.—E. E.
- BOHL, W. H., AND S. P. GORDON. 1958. A range extension of *Meleagris gallopavo mexicana* into Southeastern New Mexico. *Condor*, 60: 338-339.
- BUCKLEY, P. A. 1958. The birds of Baxter Creek, fall and winter of 1954. *Proc. Linnaean Soc. N. Y.*, Nos. 66-70: 77-83.—Unusual birds appearing in a temporary land-fill.—E. E.
- CARLETON, G. with collab. P. W. POST AND E. J. WHELEN. 1958. The birds of Central and Prospect Parks. *Proc. Linnaean Soc. N. Y.*, Nos. 66-70: 1-60.—Annotated list of birds of two New York city parks, which have been meccas of bird observers during migration periods for three-quarters of a century. Over 250 forms have been reported from each of these parks, although very few are breeders.—E. E.
- CHAMBERLAIN, E. B. 1958. Bachman's Warbler in South Carolina. *Chat*, 22: 73-74, 77.
- COMMISSIE VOOR DE NEDERLANDSE AVIFAUNA. 1958. Naamlijst van de Nederlandse Vogelsoorten. Mededeling 1. *Limosa*, 31: 107-119.—A check-list of the 350 bird species recorded from the Netherlands, giving technical and Dutch names, and indicating which have bred since 1900. Subspecific names are not indicated. (In Dutch; brief English summary).—E. E.
- COTTRILLE, B. D. 1958. Some additional bird observations in the Northern Peninsula of Michigan. *Jack-Pine Warbler*, 36: 150-153.—Records of nesting of twenty species.
- CURRY-LINDAHL, K. 1958. [Zoogeography, population dynamics and recent faunal changes.] *Ymer*, 1: 5-57.—The zoogeography of the Scandinavian peninsula, especially the presence of the endemic lemming, *Lemmus lemmus*, suggests that there was a glacial refuge on the Norwegian coast. This may also account for the restricted distribution in Sweden of the woodpecker, *Dendrocopus medius*.

- Most Scandinavian birds entered after the glaciation from the south or the northeast. The northern invasion by certain lacustrine species may be the result of gradual drying up of habitats in southeastern Europe. (In Swedish; English summary and captions to maps.)—E. E.
- CURRY-LINDAHL, K. 1958. [Vertebrate fauna of the Sarek mountains and the Padjelanta plain in Swedish Lapland I-II.] Fauna och Flora, 53: 39-149.—104 species of birds. The hypothesis is supported that the Common Redpoll, *Carduelis (Acanthis) flammea*, after breeding in May in the coniferous forest, moves into the subalpine belt in June with the young and produces a second clutch. (In Swedish; English summary.)—E. E.
- CUTTS, E. 1958. Cattle Egret officially on S. C. list. Chat, 22: 68-69.—*Bubulcus ibis* collected and nest and eggs taken on Drum Island, Charleston harbor, South Carolina April 26, 1958. About 20 pairs.—E. E.
- DAWN, W. 1958. An anomalous Bachman's Warbler. Atl. Nat., 13 (4): 229-232.—A male seen and photographed in Charleston, S. C. April 26—June 2, 1958.—E. E.
- DI CARLO, E. O. 1958. Risultati di ricerche ornitologiche sulle montagne d'Abruzzo. Part III Gruppo del Monte Terminillo—Altipiano di Leonessa, Anni 1948-1957. Riv. Ital. Orn., 28: 145-217.—Annotated list of the Mount Terminillo and Leonessa Plateau areas of Abruzzo, southern Italy.—E. E.
- DIXON, K. L., AND W. B. DAVIS. 1958. Some additions to the avifauna of Guerrero, Mexico. Condor, 60: 407.—Seven species are mentioned.
- EASTMAN, W. 1958. Ten year search for the Ivory-billed Woodpecker. Atl. Nat., 13: 216-228.—On the basis of reports investigated from several areas in Florida and eastern Texas the author believes that a few pairs still survive.—E. E.
- EISENMANN, E. 1958. Corrigenda to "The Species of Middle American Birds" (Trans. Linnaean Soc. N. Y. vol. 7, 1955). Proc. Linnaean Soc. N. Y., nos. 66-70: unnumbered separate sheet.
- FARNER, D. S. 1958. A breeding population of *Zonotrichia leucophrys gambelii* in the northern Cascade Mountains of Washington. Condor, 60: 196.
- FUGGLES-COUCHMAN, N. R. 1958. Notes from Tanganyika. Ibis, 100: 449-451.—Fifteen species are discussed. Extensions of the ranges as given by Mackworth-Praed comprise most of this paper.—J. W. H.
- GÉROUDET, P. 1958. Aperçus ornithologiques sur la Yougoslavie. Nos Oiseaux, 24: 184-193, 213-220, 257-263, 269-272.—Observations on the birds of Yugoslavia.
- GILES, L. W., AND B. H. CRABB. 1958. Snowy Plover nesting on Lower Klamath Refuge, Siskiyou County, California. Condor, 60: 192.
- HAMILTON, W. J. III. 1958. Pelagic birds observed on a North Pacific crossing. Condor, 60: 159-164.—Fourteen species are mentioned, and some correlations are drawn between occurrence and water temperature.—D. W. J.
- HARPER, F. 1958. Birds of the Ungava Peninsula. Univ. Kansas Mus. Nat. Hist., Misc. Publ. 17: 1-171. 6 pls. 26 maps. \$2.—An annotated list of the 84 species observed by the author or on which he obtained unpublished data. His studies were made from May to October 1953, chiefly in the southern and central portions of this vast area of eastern Canada, which he defines as including all of Labrador and three-quarters of the province of Quebec.—E. E.
- ROBINS, C. R. 1958. Observations on oceanic birds in the Gulf of Panama. Condor, 60: 300-302.—Observations were made in mid-July, included fifteen species.—D. W. J.
- SCHMID, F. 1958. Notes from Dorchester County, Maryland. Atl. Nat., 13: 257-258.—Breeding records; also first Lark Bunting taken in Maryland.—E. E.

- STEWART, R. E. 1958. Distribution of the Black Duck. *Fish and Wildlife Circ.* 51: 1-7; maps.—Distribution and population densities.—E. E.
- VOLSPØ, H. 1955. The breeding birds of the Canary Islands II. Origin and history of the Canarian avifauna. *Vidensk. Medd. Dansk. Naturh. Foren.*, 117: 117-178.—The discussion of various insular trends, apparently applicable to other insular avifaunas, is of general interest. (In English.)—E. E.
- WEBBE, R. 1958. On Pinkfoot changes in the Netherlands. *Limosa*, 31: 120-128.—Changes in status of *Anser brachyrhynchus*.—E. E.
- WEBSTER, J. D. 1958. Further ornithological notes from Zacatecas, Mexico. *Wilson Bull.* 70: 243-256.—The geography and vegetation of the area are described in detail. Sixty-three species were identified and notes on each are presented.—J. T. T.
- WILLIAMS, L., K. LEGG, and F. S. L. WILLIAMSON. 1958. Breeding of the Parula Warbler at Point Lobos, California. *Condor*, 60: 345-354.—This is a report of the first recorded nesting of this species west of the Rocky Mountains. Two nests were found in festoons of a lichen, an environmental feature which resembles "Spanish moss" and another species of lichen commonly used as a nest site by this warbler in its normal range in the eastern U. S.—D. W. J.

#### ECOLOGY AND POPULATION

- BATTS, H. L., JR. 1958. The distribution and population of nesting birds on a farm in southern Michigan. Jack-Pine Warbler, 36: 131-149.—A 64 acre area, including woods, marsh and fields was studied for almost four years. 54 species nested; habitat preferences, numbers, breeding success, arrival and departure dates, and other data are given for each species.—E. E.
- BOSENBERG, K. 1958. Geschlechtverhältnis und Sterblichkeit der Nestlinge beim Haussperling (*Passer domesticus* L.). *Orn. Mitteil.*, 10: 86-88.—Sex ratio and mortality in nestling House Sparrows, studied five years. (In German.)—E. E.
- BOYD, H. 1958. The survival of White-fronted Geese (*Anser albifrons flavirostris* Dalgety & Scott) ringed in Greenland. *Dansk Orn. Foren. Tidsskr.*, 52: 1-8.—Losses in first year after banding were computed as 46 per cent in first year birds, 34 per cent in adults. Of 171 recovered, 4 were between 8-9 years old. The indication is that pre-breeders in their second and third winters return to the winter haunts of their parents, rather than dispersing.—E. E.
- HOOGERHEIDE, J., and C. 1958. Het aantal Eiderenden (*Somateria mollissima*) bij Vlieland. *Limosa*, 31: 151-155.—The Common Eider 1957 population in Vlieland, the Netherlands, was estimated as at least 12,000; sex ratio, 1 to 1; one year old birds, between 1500-2000; nests, about 3000. (In Dutch; English summary.)—E. E.
- LIVERSIDGE, R. 1958. The bird population on the Free State Goldfields. *Ostrich*, 29: 107-109.—Artificial evaporation dams in the South African goldfields have created a new habitat, particularly for ducks and waders.—E. E.
- MEIER, O. G. 1958. Die Entwicklung der Seevogelkolonie auf Trischen in den Jahren 1956/57. *Orn. Mitteil.*, 10: 101-104.—Changes in a sea-bird colony (consisting chiefly of four species of terns and three of gulls) on a sandy habitat in northern Germany. Habitat and population changes are treated. (In German.)—E. E.
- PFEIFER, S., and W. KEIL. 1958. Versuche zur Steigerung der Siedlungsdichte höhlen- und freibrütender Vogelarten und ernährungsbiologische Untersuchungen an Nestlingen einiger Singvogelarten in einem Schadgebiet des Eichenwicklers (*Tortrix viridana* L.) im Osten von Frankfurt am Main. *Biol. Abhand.*, 15/16:

- 1-52.—In a 75 acre test plot of forest near Frankfurt, Germany, by providing nest boxes and other nest facilities the breeding bird population was increased from 158 broods in 1951 to 1026 in 1956. 7976 nestlings of ten passerine species were provided with neck collars to check the food brought them during an outbreak of the oak moth (*Tortrix*); a major part of the food consisted of some stage of this insect. (In German; English, French and Russian summaries.)—E. E.
- SEDWITZ, W. 1958. Six years (1947-1952) nesting of Gadwall (*Anas strepera*) on Jones Beach, Long Island, N. Y. Proc. Linnaean Soc. N. Y., Nos. 66-70: 61-70.
- SEDWITZ, W. 1958. Five year count of the Ring-billed Gull (*Larus delawarensis*) on western Long Island. Proc. Linnaean Soc. N. Y., Nos. 66-70: 71-76.
- SOLLIE, J. F. 1958. Nordostpolderbewoners, 10e bericht; broedseizoenen 1953 t/m 1957. Limosa, 31: 133-151.—Tenth annual report of changes in breeding birds and their habitats since the filling of the North-East Polder, the Netherlands. (In Dutch; English summary.)—E. E.
- TEN KATE, C. G. B. 1958. De Broedvogels van Oostelijk Flevoland in 1957. Limosa, 31: 31-43.—Changes resulting from drainage in the breeding birds of an area in the Netherlands. (In Dutch; English summary.)—E. E.
- WELLER, M. W., B. H. WINGFIELD, and J. B. LOW. 1958. Effects of habitat deterioration on bird populations of a small Utah marsh. Condor, 60: 220-226.—Due to drought conditions, the vegetation of a small marsh deteriorated materially, and over a period of five years a coincident reduction in bird populations was recorded. Duck populations dropped from 6.6 to 2.7 nests per acre and most colonies of wading birds disappeared.—D. W. J.
- WENDLAND, V. 1958. Zum Problem des vorzeitigen Sterbes von jungen Greifvögeln und Eulen. Vogelwarte, 19: 186-191.—On the problem of the premature death of young hawks and owls. The author calls "Cainism" the tendency of the older nestling to kill and devour a younger sibling. He discusses the European species in which this has been noted, and concludes that this behavior is significant in population dynamics by improving the chances that the older nestling will get enough food to survive.—E. E.

#### EVOLUTION AND GENETICS

- BRILES, W. E., C. P. ALLEN, and T. W. MILLEN. 1957. The B blood group system of chickens. I. Heterozygosity in closed populations. Genetics, 42: 631-648.
- CARNE, H. R., and W. L. WATERHOUSE. 1958. Sex reversal and abnormal sex ratios in the domestic fowl. Journ. Heredity, 49: 102, 106.
- COLE, R. K. 1957. Congenital loco in turkeys. Journ. Heredity, 48: 173-175.
- MAL'CHEVSKY, A. S. 1958. On the biological races of the Common Cuckoo, *Cuculus canorus* L. on the territory of the European part of the USSR. Zool. Zh., 37: 87-95.—"Biological races" of the Cuckoo laying certain types of eggs and favoring particular species as hosts do not exclude each other geographically, though they appear to have different centers of distribution and often occupy different biotopes or concentrate near the nests of different bird species. (In Russian; short English summary.)—E. E.
- MORGAN, W. 1958. White pheasants among Ring-necked Pheasants in South Dakota. Wilson Bull., 70: 281-284.—A white male *Phasianus colchicus*, reared artificially, appeared to be homozygous recessive, since white  $F_2$  offspring appeared in the expected ratio. The incidence and possible future of white pheasants are discussed.—J. T. T.

- NEWCOMER, E. H. 1957. The mitotic chromosomes of the domestic fowl. *Journ. Heredity*, 48: 227-234.—"The mitotic chromosome complement of the domestic fowl apparently consists of 12 chromosomes in the male and 11 in the female."
- POOLE, H. K., and M. W. OLSEN. 1957. The sex of parthenogenetic turkey embryos. *Journ. Heredity*, 48: 217-218.—The gonads of 67 parthenogenetic turkey embryos were all found to be male.—J. C. H.
- RABOR, D. S., and A. L. RAND. 1958. Jungle and domestic fowl, *Gallus gallus*, in the Philippines. *Condor*, 60: 138-139.
- RIPLEY, S. D. 1957. Comments on the West Indian Honeycreeper or Bananaquit from Grenada and its near relative on St. Vincent. *Evolution*, 11: 445-448.—A new collection of 28 specimens of *Coereba flaveola atterima* from Grenada supports the view that a lighter colored phenotype occurs at both ends of the island where it interbreeds freely with a darker phenotype which occurs throughout the island. This situation is thought to represent a case of balanced polymorphism in the two isolated mixed populations.—J. C. H.
- SANDNES, G. C. 1957. Fertility and viability in intergeneric pheasant hybrids. *Evolution*, 11: 426-444.—Data are presented of the results obtained in crosses between the genera *Gallus*, *Phasianus*, *Syrnaticus*, and *Chrysolophus*. Viable young were obtained in crosses of *Phasianus* with each of the other genera. It is suggested that *Gallus* separated off first from the *Phasianus* group followed appreciably later by *Syrnaticus*, and soon afterwards by *Chrysolophus*.—J. C. H.
- SAVILE, D. B. O. 1958. The loon wing. *Evolution*, 12: 263.
- VON HAARTMAN, L. 1957. Adaptation in hole-nesting birds. *Evolution*, 11: 339-347.—Adaptations to the hole-nesting habit are influenced chiefly by the safety of these sites and the competition for them. Territorial behavior is centered at the nest-hole and begins only after males find a hole. The males demonstrated the nesting-hole during courtship display. The safety of nesting-holes has led to a number of adaptations: frequent polygamy, hissing notes, lack of cryptic coloring of eggs, large clutch size, and slow development of eggs and young. These adaptations exist in direct proportion to the length of time a species has had the hole-nesting habit. Hole-nesting species tend to have more subspecies which is correlated with the fact that they have larger clutches and are more often non-migratory.—J. C. H.
- WILCOX, F. H., JR., and R. K. COLE. 1957. The inheritance of differences in the lysozyme level of hen's egg white. *Genetics*, 42: 264-272.
- WILCOX, F. W. 1958. Studies on the inheritance of coloboma of the iris in the domestic fowl. *Journ. Heredity*, 49: 107-110.

#### GENERAL BIOLOGY

- BROWN, L. H. 1958. The breeding of the Greater Flamingo *Phoenicopterus ruber* at Lake Elmenteita, Kenya Colony. *Ibis*, 100: 388-420.—Observations were made of over 13,000 pairs of Greater Flamingos breeding in colonies in East Africa where the species rarely is known to breed. Under general observations and breeding biology the following topics are discussed: numbers; food, feeding and need for water; voice; display, development of colonies from display grounds; mating; nests and eggs; incubation period; young; behavior of adults with young; mortality; predation; breeding success.—J. W. H.
- DICKERMAN, R. W. 1958. The nest and eggs of the White-throated Flycatcher. *Condor*, 60: 259-260.

- EATON, S. W. 1958. A life history study of the Louisiana Waterthrush. *Wilson Bull.*, 70: 211-236.—Activities of *Seiurus motacilla* before and during the breeding season, as observed in central New York State, are described and also compared with those of the related Ovenbird (*S. aurocapillus*). Plumage variation, nesting activities and success, development of fledglings, and food habits through the year are included.—J. T. T.
- FRITSCH, L. E., and I. O. BUSS. 1958. Food of the American Merganser in Unakwik Inlet, Alaska. *Condor*, 60: 410-411.
- GREVE, K. 1958. Zum Freibrüten der Haussperlinge (*Passer domesticus*) und des Feldsperlings (*Passer montanus*) aus Neuwerk. *Orn. Mitteil.*, 10: 176.—In 1958 at Neuwerk, Germany, many nests of House Sparrows and one of the European Tree Sparrow were found in the open on trees or shrubs, rather than in the usual holes and crannies.—E. E.
- GROSS, A. O. 1958. Life history of the Bananaquit of Tobago Island. *Wilson Bull.*, 70: 257-279.—The nesting and feeding habits of *Coereba flaveola luteola* on a West Indian island are described in detail. These birds are very common and tame, nest close to human activities, and frequently eat sugar or sweetened liquids supplied by man.—J. T. T.
- HEIM, R. 1958. Gewölle von Waldkausen (*Strix aluco*) aus dem Westerwald und von Schleiereulen (*Tyto alba*) aus Bonn. *Orn. Mitteil.*, 10: 141-147.—An analysis of the prey of the Tawny Owl and Barn Owl in Germany, based on their pellets. (In German.)—E. E.
- HUMPHREY, P. S., and R. E. PHILLIPS. 1958. The odor of the Crested Auklet. *Condor*, 60: 258-259.
- JOHNSON, A. W., F. BEHN, and W. R. MILLIE. 1958. The South American Flamingos. *Condor*, 60: 289-299.—An important contribution to scanty knowledge of three endemic species: *Phoenicoparrus jamesi*, *P. andinus*, and *Phoenicopterus chilensis*. Herein is described the first discovery of the nests of *jamesi*, these being located in a remote mixed colony of 3,000 other flamingos in Bolivia. Much new information on habits, movements and distribution in the Andes of Northern Chile and Bolivia is presented as the result of five weeks afield. In spite of repeated nest depredations by local people, the numbers of these birds have not appreciably declined.—D. W. J.
- KASPARSON, G. R. 1958. [Feeding habits of some diurnal predatory birds in Latvian SSR.] *Zool. Zh.*, 37: 1389-1396. (In Russian; short English summary; tables give technical names of prey species.)
- KRASSOWSKY, L. N., and G. A. TROITSKY. 1958. [Some peculiarities of the autumnal feeding of the Black and Wood-Grouse in the northern Ural in the year of the failure of the berries.] *Zool. Zh.*, 37: 1416-1417. (In Russian; English summary.)
- LACHNER, R. 1958. Rotrückengewürger (*Lanius collurio*) jagd Schnecken. *Orn. Mitteil.*, 10: 195-197.—Red-backed Shrike feeding on snails, with mention of other snail-eating passerines, and photos. (In German.)—E. E.
- LAUBINGER, G. 1958. Ungewöhnlicher Biotop der Sumpfohreule (*Asio flammeus*) in USA. *Orn. Mitteil.*, 10: 176.—Short-eared Owls roosting in trees in winter near Detroit, Michigan. (In German.)—E. E.

#### MANAGEMENT AND CONSERVATION

- ALLAN, P. F. 1956. A system for evaluating coastal marshes as duck winter range. *Journ. Wildl. Mgt.*, 20: 247-252.—Describes a system of evaluating the quality of winter duck habitat in marshes on the Gulf Coast; the system is based upon the

ecological relationships of the coastal marsh plants and the value of the marsh plants as duck foods. The system is similar to a qualitative classification of range for livestock. The classification of marshes for ducks is based on the percentage composition of the important food plants of ducks, plus allowable percentages of secondary food plants. Noteworthy is the fact that ducks find their greatest food supply among plants which are low in the successional scale in coastal marshes.—R. F. L.

BERG, P. F. 1956. A study of waterfowl broods in eastern Montana with special reference to movements and the relationship of reservoir fencing to production. *Journ. Wildl. Mgt.*, 20: 253-262.—This study in 1953-54 was based on a sample of 12 fenced and 12 unfenced (control) ponds. Average size of the 24 ponds was 2.12 surface acres at high water level. Unstable water levels appeared to limit the establishment and maintenance of emergent vegetation; thus, the effects of fencing on vegetative growth could not be determined. Nor were conclusions reached on the effects of fencing on brood production. Individuals of 40 broods were marked in 1954 to clarify movements between 44 selected reservoirs. Nine marked broods moved overland a mean distance of 0.71 miles, and the individual broods occupied between two and four ponds; movements were generally from small to larger ponds, and from ponds with greater water loss to those with less water loss. Observations of 16 marked "resident" broods indicated that larger ponds, with emergent vegetation and low water loss, provided the best brood habitat.—R. F. L.

BLANK, T. H., and J. S. ASH. 1956. Marker for game birds. *Journ. Wildl. Mgt.*, 20: 328-330.—Describes a plastic back-tab used to mark upland game birds (in England) for individual recognition at distances up to 100 yards with binoculars or telescope.—R. F. L.

CRAIGHEAD, J. J., and D. S. STOCKSTAD. 1956. A colored neckband for marking birds. *Journ. Wildl. Mgt.*, 20: 331-332.—Describes a simple, strap-like neckband for marking Canada geese; the neckband is looped about the bird's neck and is secured with a jesse knot.—R. F. L.

GEHRKEN, G. A. 1956. Shrub lespedeza as a quail management plant in southeastern Virginia. *Journ. Wildl. Mgt.*, 20: 239-242.—To determine whether shrub lespedeza plantings tend to increase quail populations in southeastern Virginia, from four to eight border strips of bicolor lespedeza totaling 1-acre were planted on each of 15 objectively selected farms in 15 different counties during the fall of 1948. There were no untreated farms studied for comparisons, but data on quail population trends were obtained through selected hunter-cooperators. The findings for the 5-year period, 1949-53, showed that the quail populations on the farms where the lespedeza plantings were made followed the same gradual, declining trend as did the population elsewhere in southeastern Virginia. It is concluded that lespedeza plantings did not increase quail populations. Records from 10,083 hours of hunting during 1949-53 showed that an average of 0.74 coveys were located and 0.93 quail were killed per hour afield; the average sex ratio was 115.7 males per 100 females, and the proportion of juveniles was 81.6 per cent.—R. F. L.

HAMMOND, M. C., and W. R. FORWARD. 1956. Experiments on causes of duck nest predation. *Journ. Wildl. Mgt.*, 20: 243-247.—Tests showed that (1) tracks or trails of the observer did not cause significant increases in losses of nests to predators, (2) activities of the observer did not cause an increase in the rate of nest desertion, except during egg-laying stages, (3) nest markers and trails of the observer caused

an increase in nest losses due to trampling by livestock, and (4) the deposition of feces on the nests by hens that were flushed by the observer may have caused an increase in the losses of nests to predators. Authors concluded that "... the energies devoted to studies aimed at measuring moderate differences in waterfowl nesting success from year to year, between localities, or between habitats would be more wisely diverted to other lines of endeavor if the method of study involves approaching nests and flushing ducks from them."—R. F. L.

STEEL, P. E., P. D. DALKE, and E. G. BIZEAU. 1956. Duck production at Gray's Lake, Idaho, 1949-1951. *Journ. Wildl. Mgt.*, 20: 279-285. Emergent vegetation covers 90 per cent of the marsh; hardstem bulrush is the dominant emergent plant. The breeding population on the marsh was estimated at 15,000 ducks in 1949, 12,000 in 1950, and 10,000 in 1951. Mallards and pintails comprised about 50 per cent of the total breeding population for the three years. Nest densities for marsh and upland sites were 47, 39, and 15 nests per 100 habitat acres for 1949, 1950, and 1951, respectively. Nest densities were highest near the largest, continuous body of open water on the marsh. Nest success of all duck species averaged approximately 70 per cent for the three years; egg hatchability in successful nests was 88 per cent.—R. F. L.

WESTERSKOV, K. 1956. Age determination and dating nesting events in the willow ptarmigan. *Journ. Wildl. Mgt.*, 20: 274-279.—Presents a reference chart, based on findings from Norway, for dating nesting events of the willow ptarmigan, *Lagopus lagopus*; chart shows (1) date of first egg, (2) date of onset of incubation, (3) date of hatching, (4) rate of primary wing molt, and (5) age of young at opening of hunting season. Willow ptarmigan retain the outermost two wing primaries during the first year. Findings showed that egg laying occurred between May 18 and July 13, the mean clutch size from 129 nests was 9.5 eggs, the egg-laying rate was 1.1 days per egg, and the mean incubation period was 21 days. These findings appear to correspond to Canadian and Alaskan conditions. Methods of distinguishing adults from young and of determining the age of ptarmigan chicks are also discussed. R. F. L.

#### MIGRATION AND ORIENTATION

ANONYMOUS. 1958. Banded birds reported and traced. *Jour. Brit. Guiana Mus. and Zoo*, 18: 10-11.—Seven Common Terns banded in Mass. or Long Island, N. Y., were all taken in British Guiana the winter or spring following their banding.—E. E.

CHAMBERLAIN, B. R. 1958. Evening Grosbeaks fly south again. *Chat*, 22: 51-54.—The unprecedented irruption of 1957-58, which reached Alabama, Georgia and coastal South Carolina.—E. E.

DROST, R. 1958. Über die Ansiedlung von jung ins Binnenland verfrachteten Silbermöwen (*Larus argentatus*). *Vogelwarte*, 19: 169-173.—Discusses the dispersal of young Herring Gulls transported from the North Sea to the zoo in Frankfurt am Main and allowed to fly free.—E. E.

EBER, G. 1958. Zum einflug der Dreizehenmöwe im Spätwinter 1957 nach Westdeutschland *Vogelwelt*, 79: 9-14.—On an incursion of the Kittiwake (*Rissa tridactyla*) into western Germany in February and March 1957. (In German.)—E. E.

GARDNER-MEDWIN, D., and J. MURRAY. 1958. A search for spring migrants in the western Pyrenees 1957. *Ibis*, 100: 313-318.—The authors observed migration for three weeks in March and April in the western Pyrenees, Spain. Species and

- numbers of birds seen are given, and weather in relation to migration is discussed.—J. W. H.
- HARKER, J. E. 1958. Diurnal rhythms in the animal kingdom. *Biol. Rev.*, **33**: 1-52.—The possession by migratory birds of "internal clocks," which enable them to orient by the position of the sun or the stars is of special interest. This paper usefully reviews the time sense as found throughout the animal kingdom. This in most species is based on the diurnal rhythm of light and darkness, which affects the internal metabolism of the animal and keeps it in phase with the environment.—E. E.
- KORIDON, J. A. F. 1958. Het Zwarte Meer (Rayon-West). *Limosa*, **31**: 1-17.—Report on bird banding in the Zwarte-Meer Reserve, Netherlands. Eelbaskets were particularly effective in capturing rails. (In Dutch; English summary.)—E. E.
- KUMARI, E. 1958. Visible migration in the East Baltic area. *Ibis*, **100**: 503-514.—Data is discussed on movements, migration pathways, flocking, and numbers of various species, mostly water birds. Information was gleaned from systematic investigation in recent years, with work being organized and coordinated by the Baltic Commission for the Study of Bird Migration.—J. W. H.
- LACK, D. 1958. The return and departure of swifts *Apus apus* at Oxford. *Ibis*, **100**: 477-502.—Six years of study have produced information on migratory behavior and its relationship to weather, mating, breeding, development of young and food supply. Spring arrival was delayed with a cold northerly airstream. The normal date for the return of swifts in May has been evolved through the advantage of laying eggs near the end of the third week of May. Cold weather in May can reduce clutch size or inhibit breeding altogether until warm weather. Lack's thesis that time of breeding season is governed by need of food supply for the young may be modified to include the need for enough food for the female at the time of laying. Members of the same pair usually arrived and departed in migration on different days. Time of departure in fall depends on when breeding started and hence on the weather in May. Parents delayed departure for a few days after the young left, apparently to gain fat. When weather was bad in July this delay was longer; in one year it was longer with parents of larger than average broods. In fine summers one parent may depart before the young. Adults whose eggs failed to hatch left earlier than successful breeders. Non-breeding yearlings departed the latest. Weather depression and mist may delay departure. After their mates departed, some swifts "kept company" with other individuals.—J. W. H.
- MERKEL, F. W. 1958. Untersuchungen zur künstlichen Beeinflussung der Aktivität gekäfigter Zugvögel. *Vogelwarte*, **19**: 173-185.—The effect on "Zugunruhe" (migratory restlessness) of administration of Thyroxin, Insulin, Methylthiouracil, ultraviolet light, and DOCA (Desoxycorticosteronacetate).—E. E.
- OWEN, J. 1958. Autumn migration in southwest Portugal, 1957. *Ibis*, **100**: 515-533.—A party of six observers recorded migration and related weather phenomena from August 23 to September 25, 1957, at Cape St. Vincent, south west Portugal. Species, numbers, direction and time of migration, and fluctuation of intensity of movements are discussed. A northwesterly wind encouraged migration, a southeasterly or easterly one discouraged it. A cold front in the Pyrenees seemed to block migration of small nocturnally moving passerines into the area. All birds noted departing from the Cape flew south or southeast, out to sea.—J. W. H.
- PERDECK, A. C. 1958. Two types of orientation in migrating Starlings, *Sturnus vulgaris* L., and Chaffinches, *Fringilla coelebs* L., as revealed by displacement experiments. *Ardea*, **46**: 1-37.—Starlings captured during fall migration and dis-

- placed many miles to the east yielded 354 recoveries. Adults and juveniles held different courses after displacement. No significant differences were found in situations where juveniles and adults were released together or separately. Adults had a tendency to return eventually to the original area, whereas the juveniles had a clear tendency to remain in the area reached after their displacement. A similar experiment was conducted with Chaffinches. The results, although more meager than those obtained with Starlings, suggest the same phenomena.—W. C. D.
- SCHMIDT-KOENIG, K. 1958. Experimentelle Einflussnahme auf die 24-Stunden-Periodik bei Breittauben und deren Auswirkungen unter besonderer Berücksichtigung des Heimfindevermögens. *Zeitschrift für Tierpsychologie*, 15: 301-339.—This is a report on an experiment dealing with the problem of bird orientation towards a distant goal regardless of its direction. Results show more accurate orientation among the pigeons with their lofts toward the north than among those having to fly towards the south. This is consistent with directional differences found previously in southeastern U. S. A. as well as in Germany. (English summary). W. C. D.
- VAUK, G. 1958. Massensterben von Zugvögeln im April 1958 auf der Insel Helgoland. *Orn. Mitteil.*, 10: 181-183.—Mass death of migrants in April on Helgoland, apparently from starvation.—E. E.
- VON SAINT-PAUL, U. 1958. Neue experimentelle Ergebnisse über Fernorientierung der Tiere. *Vogelwarte*, 19: 193-198.—A review of recent experiments by various workers on distant orientation by animals, with useful literature references.—E. E.
- WILLIAMSON, K. 1958. Autumn immigration of Redwings *Turdus musicus* into Fair Isle. *Ibis*, 100: 582-604.—The migrations of two races at Fair Isle are compared. Continental Redwings (*musicus*) usually appear at Fair Isle with easterly or southeasterly winds, most prevalent in early October. Icelandic birds (*coburni*) generally arrive in October, but at times of cyclonic westerly or north-westerly winds. If the two races respond alike to weather at the time of departure and during the journey, then certain movements containing a larger than normal number of Icelandic birds must originate in southern Greenland, the flocks having previously crossed Denmark Strait from Iceland in clear weather with light easterly winds.—J. W. H.

#### PHYSIOLOGY

- JOHNSTON, D. W. 1958. Sex and age characters and salivary glands of the Chimney Swift. *Condor*, 60: 73-84.—Although no external dimorphic characters were discovered, it was possible to distinguish yearlings by the absence of molt in the fall plus their relatively large unossified skull "windows." Salivary glands were weighed and sectioned, thus indicating that these glands follow a seasonal recrudescence similar to the gonads. It is suggested that the enlargement of the salivary glands is under the joint control of testosterone, thyroxine, and hormone(s) from the pituitary gland.—D. W. J.
- KATO, Y., AND F. MOOC. 1958. Difference in response of phosphatases in chick embryo to injection of substrate. *Science*, 127: 812-813.
- MANWELL, C. 1958. Respiratory properties of the hemoglobin of two species of diving birds. *Science*, 127: 705-706.—Studies were made of the blood of the Western Grebe (*Aechmophorus occidentalis*) and the White-winged Scoter (*Oidemia deglandi*). It was found that the properties of the hemoglobins of these birds were essentially identical to those of other birds.—J. C. H.
- MEWALDT, L. R. 1958. Pterylography and natural and experimentally induced

- molt in Clark's Nutcracker. Condor, 60: 165-187.—A significant and detailed study of pterylography in about 500 specimens. Generally, pterylography and molt were quite similar to those in *Aphelocoma coerulescens* and some other species of Corvidae. By increasing the photoperiod to 16 hours a postnuptial-like molt was induced in December and January whereas the controls on a normal photoperiod did not molt until March and April. Plumage differences, weight of bursa of Fabricius, and measurements are expressed for the various age groups and sexes.—D. W. J.
- ROBERSON, R. H., AND P. J. SCHABLE. 1958. Zinc requirement of the chick. Science, 127: 875.
- SEGAL, S. J. 1957. Response of Weaver Finch to chorionic gonadotrophin and hypophysial leuteinizing hormone. Science, 126: 1242-1243.—Human chorionic gonadotrophins elicited the deposition of pigment in regenerating feathers of Weaver Finches of both sexes.—J. C. H.
- VAN DER HELM, H. J., AND T. H. J. HUISMAN. 1958. The two hemoglobin components of the chicken. Science, 127: 762.

#### TAXONOMY AND PALAEONTOLOGY

- ABBOTT, J. M. 1958. Hybrid White-crowned x White-throated Sparrow. Atl. Nat., 13: 258-259.—Fort Belvoir, Virginia, Jan. 5, 1958.
- BOCK, W. J. 1958. A generic review of the plovers (Charadriinae, Aves). Bull. Mus. Comp. Zool., 118, no. 2: 27-97.—The plovers are reduced to a subfamily, in which the Vanellinae are merged; the 32 genera and 61 species of Peters' Check-list become 6 genera and 51 species. The major consolidation is in the lapwings, where the 19 genera recognized by Peters become one, *Vanellus*; as a result, the specific name of *Rogibyx tricolor* has to be changed to *V. macropterus* (Wagler). Six small genera (including *Eupoda*) are merged in *Charadrius*, and *Squatarola* (as well as the monotypic *Pluviorhynchus* of New Zealand) disappears in *Pluvialis*. Bock strongly condemns Lowe's anatomical and phylogenetic treatment of the plovers. He persuasively argues that the chief skull characters relied on by Lowe to distinguish *Squatarola* from *Pluvialis*, *Leucopoliis* from *Charadrius*, and his Charadriinae from Vanellinae, are essentially aspects of the degree of ossification of the preorbital rim, which depends upon the size of the salt gland, which in turn reflects the salinity of the environment in which the bird lives. While the degree of ossification varies with age, lack of ossification of the preorbital area in adults is not, as Lowe contended, an indication of phylogenetically primitive character, but rather of life in a highly saline environment.—E. E.
- PLÓTNICK, R. 1958. Posición sistemática del género "Psilorhamphus" (Rhinocryptidae, Passeriformes). Physis, 21, no. 60, 130-136. (In Spanish, with English summary.)—*Psilorhamphus guttatus* (Ménétrières) found in wooded regions from southeastern Brazil to Misiones, Argentina, on the basis of external characters has been listed uncertainly in the Formicariidae, with suggestions for transfer to the Troglodytidae, or the Sylviidae (near *Ramphocaenus*). Dissection of two specimens shows a tracheal syrinx, and a four-notched sternum, generally similar to those of *Scytalopus*. The genus is placed in the family Rhinocryptidae.
- PRIGOGINE, A. 1958. The status of *Eremomela turneri* van Someren and the description of a new race from the Belgian Congo. Bull. Brit. Orn. Club, 78: 146-148.—*Eremomela turneri* found to be sympatric with *E. badiceps*, of which it has been regarded as a subspecies. A new subspecies *E. turneri kalindei* described from the Belgian Congo.—E. E.

- RIPLEY, S. D. AND D. S. RABOR. 1958. *Columba vitiensis anthracina* (Hachisuka), a reconsideration. *Condor*, 60: 192-193.
- SKEAD, C. J., AND G. A. RANGER. 1958. A contribution to the biology of the Cape Province White-eyes (*Zosterops*). *Ibis*, 100: 319-333.—The ranges of two forms of White-eye (*Z. atmorii*, grey-bellied, and *virens*, green-bellied) overlap geographically and ecologically. Their current status as species is obviously incorrect; based on many examples of mixed pairs breeding, mixed flocks, like behavior and voice, their status as color morphs of the same species is thoroughly established. White eggs have been found only in nests of paired grey-bellied individuals. Young of mixed pairs are either all of the grey-bellied type or all of the green-bellied type. *Z. pallida*, a third form of more arid parts of the province is similar in habits to the above forms, and differs in tonal quality of voice. It is not known to interbreed with other white-eyes.—J. W. H.
- SLUD, P. 1958. Observations on the Nightingale Wren in Costa Rica. *Condor*, 60: 243-251.—Based upon a behavioral study questions relating to the systematics of this form are reopened. Of principal importance is the observation that Costa Rican birds (presumably of the same subspecies) have two different song groups.—D. W. J.
- VAURIE, C. 1958. Remarks on some Corvidae of Indo-Malaya and the Australian region. *Amer. Mus. Novitates*, 1915: 13 pp.—Species of *Corvus* reviewed are *enca*, *typicus*, *florensis*, *kubaryi*, *validus*, *woodfordi*, *coronoides*, *bennetti*, and *orrui*. *C. enca mangoli* is described as new from Sula Mangoli. A monotypic genus (*Gazzola* Bonaparte = *Nesocorax* Riley) is rejected for *C. typicus*. Forms usually considered full species, here reduced to subspecies, are *C. enca unicolor* and *C. woodfordi meeki*. The type specimen of *C. difficilis* Stresemann is considered to be "a form of *coronoides*, probably a subadult or perhaps an aberrant specimen," or possibly a *coronoides* x *bennetti* hybrid.—K. C. P.

**Voices of African Birds.**—Recorded by Myles E. W. North. 1958. 33-1/3 RPM. 12-inch vinylite record Laboratory of Ornithology, Cornell Univ. Cornell University Records, 124 Roberts Place, Ithaca, N. Y. Price, \$7.75. This record gives the songs and calls of 42 species heard in Kenya. The record jacket gives the locality, latitude and longitude, and the month when the notes were taped. This data is valuable, for most of the species involved have a much wider African distribution than Kenya.—E. EISENMANN.

**An Evening in Sapsucker Woods.**—Produced by P. P. Kellogg and A. A. Allen. 1958. 33-1/3 RPM. 10-inch vinylite record. Laboratory of Ornithology, Cornell University. Cornell University Records, 124 Roberts Place, Ithaca, N. Y. Price, \$4.95. Songs or calls of 27 species of birds and five amphibians inhabiting a wooded research center and sanctuary at Cornell University in central New York.—E. EISENMANN.

#### SEVENTY-SEVENTH STATED MEETING OF A.O.U.

The American Ornithologists' Union will meet in 1959 at Regina, Saskatchewan. The meeting is jointly sponsored by the Saskatchewan Museum of Natural History, the Saskatchewan Natural History Society, the Regina Natural History Society, and Regina College of the University of Saskatchewan. The scientific sessions will be held in the Saskatchewan Museum of Natural History on Wednesday, Thursday, and Friday, August 26-28. The business sessions will be held on Tuesday, August 25, at the Hotel Saskatchewan (meeting headquarters). Field trips are planned for Saturday and Sunday, August 29 and 30. The Annual Banquet will be held at the Wa Wa Shrine Temple on Friday evening (registered guests only and no charge).

Applications for a position on the program should be in the hands of the Secretary not later than July 8.

Fifteen hotels and 55 eating places are located within one mile of the Museum; several motels are located within a few miles of the Museum. In addition, some 80 single beds are available at Regina College (just across the Park from the Museum) for \$1.50 per day (three meals and bed, \$3.50 per day). Frank H. Brazier, 2657 Cameron Street, Regina, is Chairman of the Subcommittee on Accommodations and Transportation.

It is hoped that we shall have good attendance at this meeting, our first in western Canada.

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#### NOTES AND NEWS

The library of the late Arthur Cleveland Bent has been presented by his widow to the University of Massachusetts, Amherst, Massachusetts. It is planned to keep adding to the library to make it a living memorial to Mr. Bent. The library will be housed in the new Science Center, opening in February, 1960, available to interested ornithologists.

The Karl P. Schmidt Fund has modest sums available to assist persons wishing to study at the Chicago Natural History Museum. Grants will be made for study in any of the four fields encompassed by the museum: anthropology (with a natural history orientation), botany, geology (including paleontology), and zoology. An applicant should describe the study proposed in brief terms, state the length of time he wishes to study at the museum and the amount of money needed, and name one reference. Applications should be mailed to: Chairman, The Karl P. Schmidt Fund, c/o Chicago Natural History Museum, Roosevelt Road and Lake Shore Drive, Chicago 5, Illinois.

#### AUDUBON PRINT OF HUTCHINS' GOOSE AVAILABLE

At the 75th Anniversary Meeting of the A.O.U. held in New York in 1958, a black-and-white print of Hutchins' Goose by Audubon, made by direct impression from the original copper plate, was given to those attending the Annual Dinner. A limited number of these prints remain. They will be sold singly for \$5.00 each to members, with the proceeds above costs going to the A.O.U. treasury. Orders with check should be sent to the Department of Birds, American Museum of Natural History, New York 24, N. Y.

## 1959 MEETING OF WILSON ORNITHOLOGICAL SOCIETY

The 1959 meeting of the Wilson Ornithological Society will be held in Rockland, Maine, June 11 to 14, at the Farnsworth Museum—the first New England meeting of the Society. Plans include field trips to Matinicus Rock and Mt. Desert Island. Advance inquiries should be addressed to: Mr. Christopher M. Packard, Portland Society of Natural History, 22 Elm Street, Portland, Maine.

## STUDENT MEMBERSHIP AWARDS FOR 1959

## Selected by the A.O.U. Committee on Student Membership Awards

Phillip Barton Ackerman, College of Wooster, Wooster, Ohio  
Ted Tipton Allen, University of Florida, Gainesville, Florida  
James E. Ambrose, Jr., Rice Institute, Houston, Texas  
Keith Alan Arnold, Kalamazoo College, Kalamazoo, Michigan  
Robert Douglas Barbee, Colorado State University, Ft. Collins, Colorado  
Jon Charles Barlow, University of Kansas, Lawrence, Kansas  
Ruth Ann Berberian, Cornell University, Ithaca, New York  
Stephen C. Bromley, Brigham Young University, Provo, Utah  
Paul A. Buckley, Columbia University, New York, New York  
Roger Barnum Clapp, Cornell University, Ithaca, New York  
Robert Armin Compton, Pennsylvania State University, State College, Pennsylvania  
Robert Stewart Constable, University of California at Los Angeles, California  
James Livingston Craig, Cornell University, Ithaca, New York  
Rudolf Herman Drent, University of British Columbia, Vancouver, Brit. Columbia  
David Arlen Easterla, University of Missouri, Columbia, Missouri  
Jean E. Finzel, University of Wyoming, Laramie, Wyoming  
Stanley Earl Hedeon, Evanston Township High School, Evanston, Illinois  
Hugh Bradford House, University of Wyoming, Laramie, Wyoming  
Laurence Graham Isard, Kent State University, Kent, Ohio  
R. Roy Johnson, University of Arizona, Tucson, Arizona  
Barbara Orcutt Keeton, Cornell University, Ithaca, New York  
Lloyd B. Keith, University of Wisconsin, Madison, Wisconsin  
Gordon Austin Knight, University of West Virginia, Morgantown  
Jean H. Linford, Utah State University, Logan, Utah  
Barbara Ann Lund, Cornell University, Ithaca, New York  
Dale Whitney Matheson, Bowdoin College, Brunswick, Maine  
Lois McCollough, Judson College, Marion, Alabama  
Martin Cadbury Michener, Cornell University, Ithaca, New York  
Larry Calmer Oglesby, Florida State University, Tallahassee, Florida  
James Franklin Parnell, North Carolina State College, Raleigh, North Carolina  
Clement John Ralph, University of California at Berkeley, California  
Donald Cave Rhoads, Cornell University of Iowa, Mt. Vernon, Iowa  
Daniel Charles Rosenthal, Grinnell College, Iowa  
Philip C. Shelton, Montana State University, Missoula  
Neal Griffith Smith, Cornell University, Ithaca, New York  
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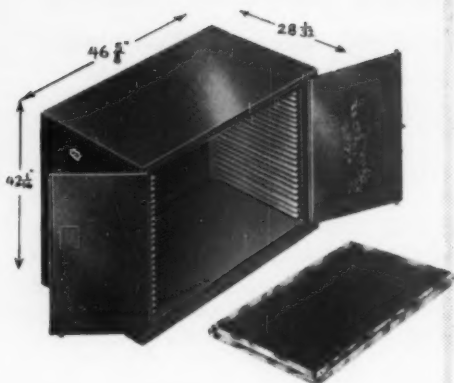
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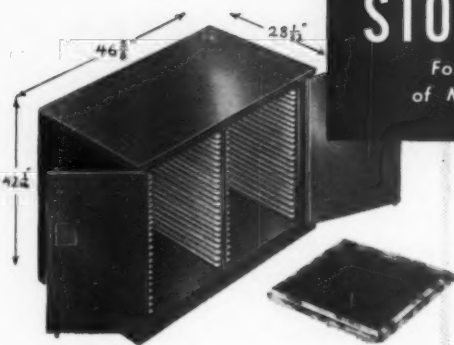
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